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Bell Molds Made of Loam on Arbors

Two to Four Rough Coats of Loam Swept on Arbor Before Smooth Coat Is Added —After Blackening a Special Wash Containing Hickory Ashes Is Used—Many Great Bells Cast in the Past

BELLS are almost universally cast in a certain definite shape, which has had its evolution from the early days when tuned pieces of metal were often employed as bells. The exact date of the origin of bells is not known. Fletcher in his "Notes on Niniveh" cites Dionysius Bar Salabi, an oriental writer, as ascribing the invention of bells to Noah. Authentic records can be found of the use of bells in the earliest times in all parts of the world. Bells were used in China, Japan, Egypt and Assyria at an early period of their exitence as nations and long before bells were known in Europe. Mention is made of bells used in camps and garrisons and in other stations by the Greeks. The Romans hung bells in public bath houses and employed them to announce public business and to assemble families. That bells were known in America before the white man settled there is shown by the bells taken from the tombs of the Peruvians and by the smaller ones brought by the trading canoes of the Indians to Columbus at Cape Honduras.

FIG. 2—THE GREAT BELL OF MOSCOW IS THE LARGEST IN THE WORLD

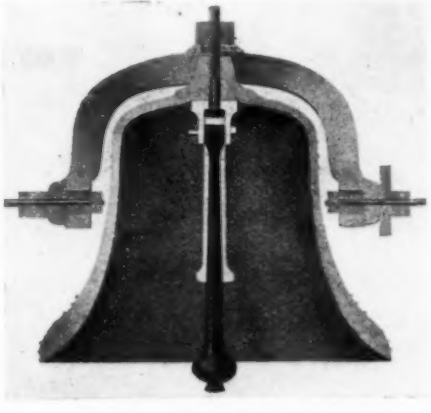


FIG. 1—BELLS ARE ATTACHED TO THE YOKE BY A SINGLE BOLT

At first only small bells were made and it was not until after Christianity became established that larger bells were produced. By the middle of the eighth century the church bell had become sufficiently common in England that orders were issued to have them tolled at certain hours. As the number of churches and monasteries increased the art of bell founding became familiar to more artisans. These latter, instead of establishing shops, drifted about the country rearing temporary foundries at convenient places to cast bells for the neighborhood. Indeed, owing to the difficulty of transporting the metals and the finished bells the castings often were made near or even in the church itself.

Copper and tin were used for casting the bells of which we have the earliest record, the only change which has been made in the composition since the first bells were cast being in the proportions of the two metals. A popular legend ascribes to silver the ability to give a specially sweet tone to a bell; but a contrary effect on the tone of the bell would be obtained were silver alloyed in the bell metal, silver being too closely allied to lead in its nature to permit its use with copper and tin to furnish tone. Iron and steel bells have been made with a view to a reduction of costs but such bells have a harsh, jangling and disagreeable tone. The tone of a bell depends upon the composition of the alloy, but it is equally governed by the shape and proportions of the bell.

The skill of the founders is shown in

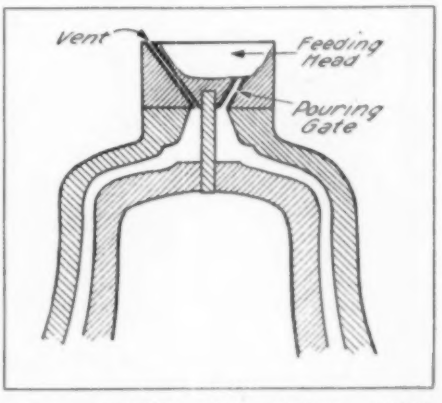


FIG. 3—BAKED AND DRIED LOAM TUBES FORM THE POURING GATE AND VENT

FIG. 4—SWEEPING ON THE FIRST ROUGH COAT OF LOAM

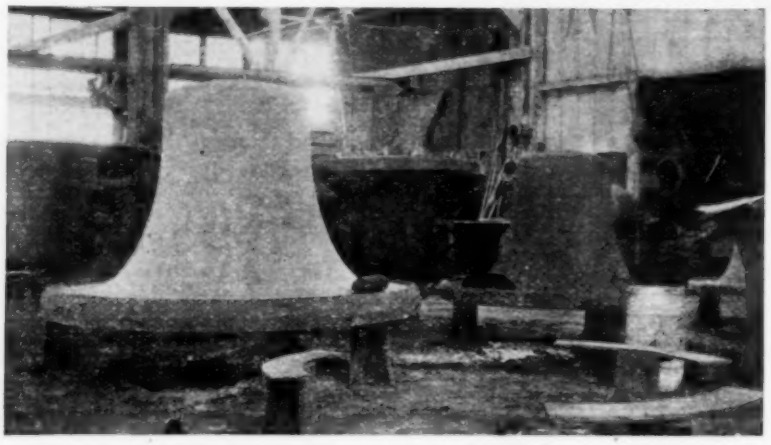


FIG. 5—THE DRAG IS FINISHED WITH A COATING OF HICKORY ASHES PUT OVER THE LAST COAT OF FINE LOAM

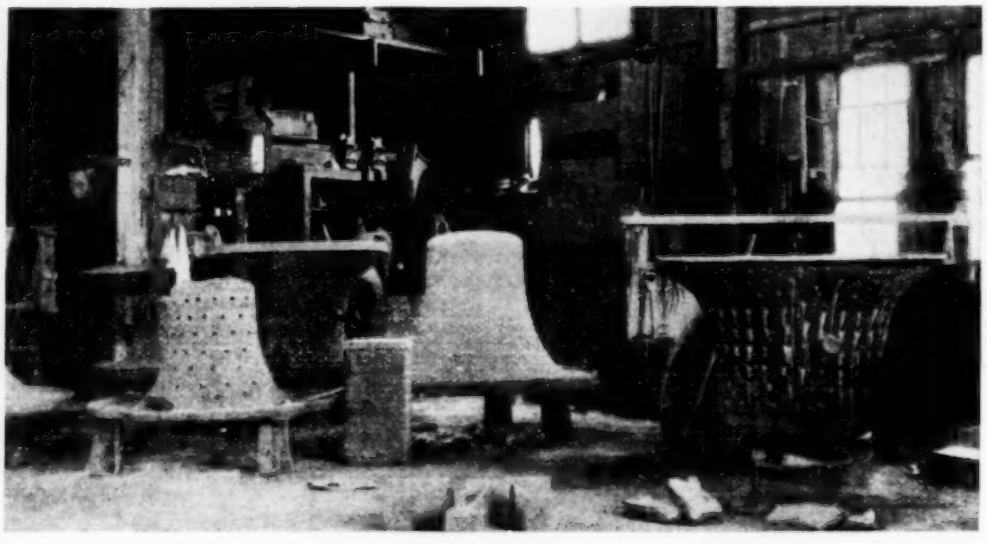


FIG. 6—THE SPINDLE FOR THE COPE IS HELD BY A CROSSBAR ATTACHED TO LUGS ON THE CAGE—NOTE AT THE LEFT A CAGE FOR THE DRAG, ONE OF WHICH STANDS NEXT TO IT

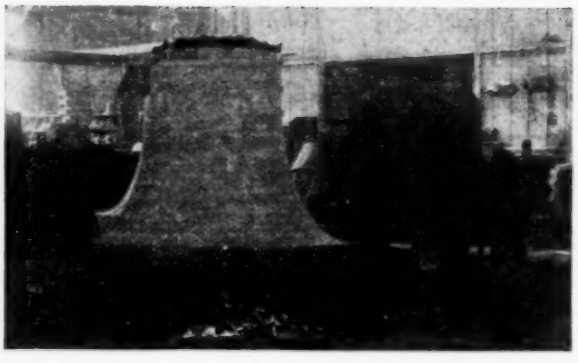


FIG. 7—AFTER EACH COAT OF LOAM IS SWEPT ON THE MOLD, A CHARCOAL FIRE IS USED TO DRY IT

FIG. 8—TWO FLASK SECTIONS BOLTED TO THE TOP OF THE COPE FORM THE HEAD AND POURING BASIN

FIG. 9—THE MOLD IS CLOSED BY DROPPING THE COPE OVER THE DRAG

many large bells to be found in remote corners of the world. A bell at St. Paul's of London, weighs 11,500 pounds; Great Tom at Lincoln, England, weighs 12,000 pounds; the Bell Jacqueline of Paris, cast in the year 1400, weighs 15,000 pounds; one at Rennes, France weighs 16,000 pounds; Great Tom of Oxford, England, weighs 17,000 pounds; Great Peter, York Minster, England, 21,000; Saint Peter's of Rome, 17,500; and one in Notre Dame cathedral, Paris, 28,560. The largest bell in America is in a cathedral at Montreal, Canada. This weighs 28,560 pounds.

The Veteran Giant of Moscow

The largest bell in the world is the "Great Bell of Moscow." This relic of medieval foundry art is 22 feet in diameter at the base and 19 feet high. Its weight is 441,000 pounds. The order for casting the bell was issued by Empress Anne, in the year 1733. It was cast from metals of an immense predecessor destroyed in 1706, together with additional new metal. An inscription on the base upon which the bell now stands indicates that it had never been rung, but remained in the ground 103 years until raised in 1836 by order of Emperor Nicholas. It is said that the intense heat together with the chilling effect of the water during the conflagration of 1812 caused the several cracks which are to be seen extending 3 to 7 feet from its base. Two of these cracks came together allowing a piece weighing 11,000 pounds to fall out, as is shown in Fig. 2.

Not only are large bells found in Christian countries, but China and Japan also have a number of great bells. The "Great Bell of China" in Pekin weighs 120,000 pounds, is 14 feet high and 12 feet in diameter at the base. A bell in Nankin, China, now fallen to the ground, weight 50,000 pounds. Japanese bells are much the same shape and composition as those of China. The bell of the Buddist monastery, Chi-on, in Kiota, Japan, cast in 1633, weighs 165,760 pounds.

Among all the bells of the world, either large or small, the one of most interest to all Americans is the famous

FIG. 10—STRIPPING THE MOLD

Liberty bell. Cast by Thomas Lester, Whitechapel, London, England, it arrived in Philadelphia in August, 1752, and was hung early in September. However, it cracked while being tested and was recast at the foundry of Pass and Stow, Philadelphia, and hung the second time on April 17, 1753. This casting also was found to be defective and was recast by the same foundrymen and again

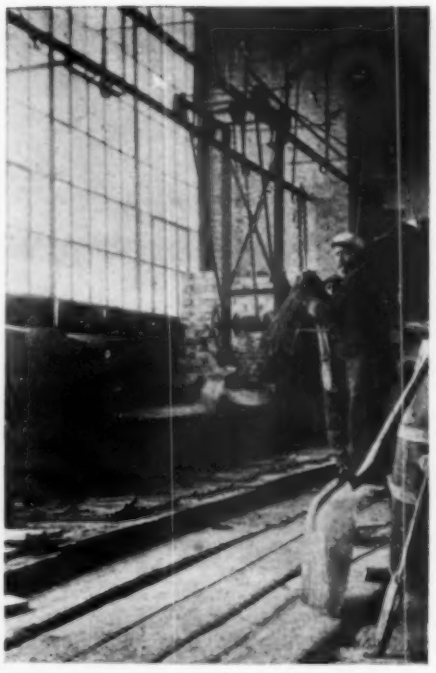


FIG. 11—METAL IS MELTED IN CRUCIBLE PIT FURNACES

hung in the State House in June of 1753. This bell is not extremely large, being only 4 feet in diameter at the lip. The distance from the lip to the crown, following the line of the bell, is 3 feet, and the weight is 2080 pounds.

Bell Cracked While Tolling

It was on July 8, 1776 that this famous old bell rang out its memorable message of liberty throughout the land. From that time the bell continued to record the events of the revolution and served until July 8, 1835. On this day, while tolling during the funeral solemnities of John Marshall, chief justice of the Supreme Court of the United States, it parted through its side and has been silent ever since.

Considering the great part bells have

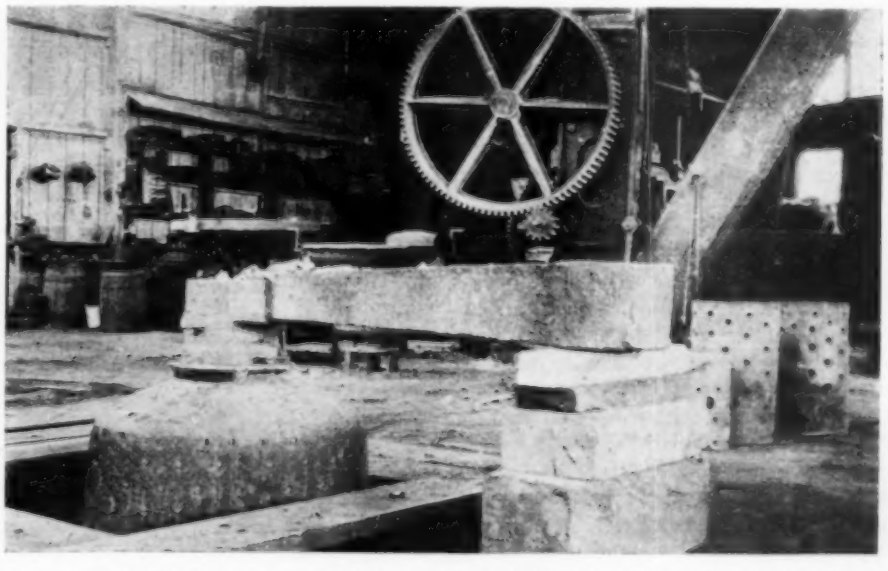


FIG. 12—WHEN THE BELL TO BE CAST WEIGHS MORE THAN 2500 POUNDS THE MOLD IS PLACED IN A PIT FOR POURING

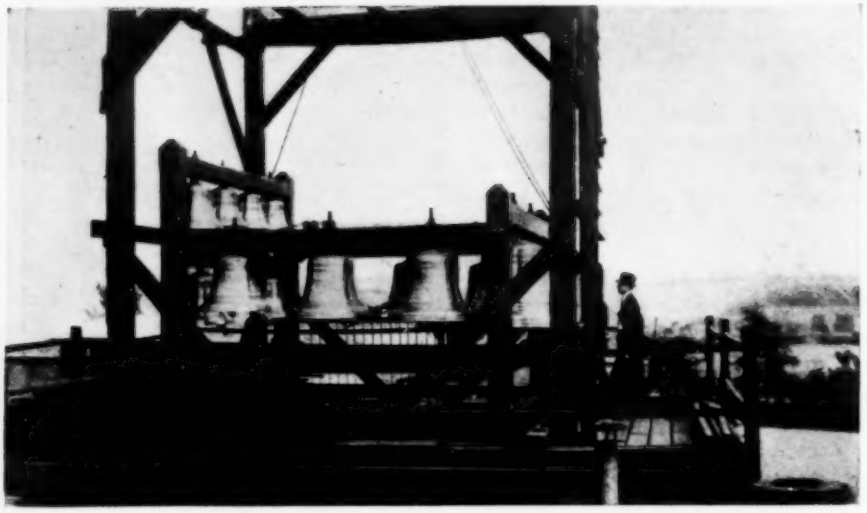


FIG. 13—CHIMES ARE SET IN A BELFRY ON TOP OF THE BUILDING FOR TESTING —EXACT NOTES ARE REQUIRED

played in the history of the world and their ancient origin it might be thought that many foundries would cast them. The contrary is true. The number of foundries in this country which cast bells is extremely small. This is due to a comparatively slight demand for bells which rarely are replaced owing to their long life. An accurate technical knowledge is needed to produce bells of the correct tone. The companies which do manufacture bells are equipped to do the work in a thorough and efficient manner and to design and finish the product in their foundry. The McShane Bell Foundry Co., Baltimore, is one of the oldest bell foundries in this country and since its organization in 1856 has cast bells and chimes for churches and public edifices throughout the country.

In addition to bells, the company makes a line of plumber's supplies which acts as a balance wheel on production when the demand for bells is slack. However, the two departments are entirely separated. The molding floor of the bell foundry is circular and is served by a revolving jib crane. The molds for the bells are formed in loam on two shells, or cages as they are called in the language of the bell molder. These cages are cast iron and are perforated with holes to provide escape for gas formed in the mold during pouring.

Drag Set on Pedestals

Fig. 4 shows the first layer of loam being swept on a core section. The sweep is held by a spindle fitted through a hole in the top of the cage. This hole later serves as a seat for the core which forms the hole in the crown of the bell. While it is being swept the drag or core cage is set on three pedestals topped with segments of a circle as may be noted in the foreground of Fig. 5. The cope is swept in a somewhat different manner. It is set on a fixed base as shown at the right in Fig. 6, and the sweep is held by a crossbar fitted to two lugs bolted to the cage. The spindle extends through a hole in the crossbar and rests on a seat in the bottom of the cage.

It is essential that the loam with which the molds are made be strong enough to withstand the pouring strain and yet be so porous that the gases in the mold and formed during pouring may escape readily. On this account, great care is taken to secure the proper kind of loam and to apply it in the most satisfactory manner. All the loam is mixed with manure to give it the necessary venting properties and it is put on in layers to give it strength. The first coat is rough and each coat is dried before another layer is added. In this way, only one coat can be put on in a day. The drying process is illustrated in Fig. 7, which shows a core in the foreground and a cope to the right. Drying is accomplished with charcoal fires built under the molds. From two to four rough coats are swept on the cage and then a final smooth coat of loam is added. When this coat has been dried, the mold is blackened and the inscription is stamped on it. Then it is painted with a coating of molasses water in which hickory ashes, secured from the smoke houses of packing firms, is mixed. These ashes are in a fine condition, having been sifted through a 100-mesh sieve. It gives an exceptionally smooth finish to the casting. A core is shown in Fig. 5 after being coated with the final layer of ashes.

The only stock core used is the one to form the hole for the bolt adapted to clamp the bell to the beam which supports it. This core ranges from 1 inch to 2¼ inches in diameter and is fitted into the two sections clamped to the cope, Fig. 8, to form the pouring basin of the bell. A procedure peculiar to bell founding is noted in the arrangement of the pouring basin. The lower section forms a head on the bell. The upper section contains two tubular pieces of loam made by hand and baked dry and hard. These two tubes form the pouring gate and vent and both are connected with the head of the bell and are surrounded with molding sand which is dried with a charcoal fire before the mold is poured. The metal in the basin serves to feed the mold as the metal contracts on setting. Fig. 3 shows the arrangement of this portion of the mold.

Crane Handles Mold

After all the coats of loam have been applied and dried, and the pouring basin is dry, the cope is closed on the drag or core by the aid of the swinging jib crane in the center of the foundry, as illustrated in Fig. 9. As may be noted, the chain from the crane is attached to two lugs provided on the cope. No means are supplied for moving the core

FIG. 14—METAL IS MIXED THOROUGHLY IN A LARGE LADLE AFTER BEING MELTED IN CRUCIBLES—TIN ADDITIONS ARE MADE IN THE LADLE

as this sets in a fixed position from the time the first coat is swept on it until the mold is ready to be poured. The edge of the cope fits into a flange around the core and this serves to locate the positions of the two. Four to eight clamps, attached to the edge of the cope and the rim of the core, hold the two in place when the mold is poured.

Metal for the molds is secured from a bank of crucible pit furnaces. A capacity of about 11,000 pounds of metal at a time is secured from 12 pits holding 700-pound crucibles and 12 pits for 250-pound crucibles. In melting, the copper and overflow bellmetal are put into the crucible and when this metal is hot enough to pour the crucible is carried to the molding floor on a trolley traveling on a double tracked runway shown in Fig. 11. Here the molten metal is poured into a ladle containing enough tin to bring the composition of the resulting alloy to the required formula. As much metal as is needed for pouring the bell is thus collected in the receiving ladle which is handled by the jib crane.

Large Bells Poured in Pit

Bells weighing 2500 pounds or more are poured in a pit. The whole mold is lifted by the crane and lowered into the pit after which a runner box is arranged on it as indicated in Fig. 12. Fig. 14 shows one of these molds being poured. Bells are allowed to remain in the mold over night and are stripped the following morning. Fig. 10 shows a bell after the cope has been removed. It may be noted that the loam is quite friable and readily falls away from both the cage and the casting. After the bells are cast they are taken to the machine shop and polished and are then ready for testing. Individual bells are tested by standing them on a low pedestal and tapping them with a mallet. The method of determining the tone and pitch is similar to that for tuning a piano, a tuning fork being used to determine the correct tone. Chimes are tested after being set on a tower on top of the building. The individual testing room may be seen in Fig. 15, and a set of chimes is shown in Fig. 13 ready to be tested. It is essential that every bell of a set of chimes be of practically the same composition and for this reason all the bells of a set of chimes are poured from metal of exactly the same mixture. Nor is the metal in any set allowed to vary greatly from the composition aimed at. The usual alloy is 20 per cent tin and 80 per cent copper. Alloys varying a few per cent from this in the amount of tin are sometimes ordered, but all bells are poured from a tin-copper mixture of approximately 20 per cent tin and 80 per cent copper. Beside the composition the other point to be watched to assure the rich correct tone of the bell is its shape and contour. This has been determined by long years of experience so that a degree of perfection has been attained which compares favorably with that secured in other musical instruments.

FIG. 15—INDIVIDUAL BELLS ARE TESTED BY STANDING THEM ON LOW PEDESTALS AND STRIKING THEM WITH A MALLET

A significant fact which tells the story of the bell foundry is that while the McShane company casts only from 200 to 400 bells a year, it has between 500 and 600 patterns of bells. These consist of patterns for single bells; for peals in which 2 to 5 bells compose a set; and for chimes. Chimes are made up of from 10 to 15 bells with an average of 11 bells. The average weight of a set of chimes made by the company is 6 tons. Single church bells vary in weight from 500 to 3000 pounds. The clappers are made of wrought iron and annealed, and are hung in the bell as illustrated in Fig. 1. The bolt which attaches the bell to the yoke which supports it also secures a spring to which the clapper is hung by a pin on a roller bearing. The spring may be identified as the white section behind the clapper. A section of this spring is on each side of the clapper, although only one leg of the spring is shown in the illustration. The object of the spring is to prevent the clapper from dangling against the bell after striking it. A somewhat similar spring is attached to chimes for the same purpose. The McShane company has designed its bells and yoke so that the bells may be turned around while still mounted. The object is to give the clapper a new striking place and thus decrease the liability of fracture.

The Pittsburgh office of the Independent Pneumatic Tool Co. has been removed from 1208 Farmers Bank building to 718 Bessemer building.

French Not German Machines—A Correction

In the Oct. 15, 1920 issue of THE FOUNDRY an article was presented in which various types of European molding machines were described and illustrated. This article had been prepared by H. Cole Estep, as a paper for the Columbus convention of the American Foundrymen's association. Recently the author's attention was called to an error in this paper as originally issued in preliminary form.

Fig. 15 on page 822, in the paper as published in THE FOUNDRY, showed a hydraulic molding machine of the swing-head type which was stated to be of German manufacture. This is entirely in error. This machine is a French, and not in any way a German production. In fact what was shown was an experimental machine, of a preliminary type afterward developed into the well-known swing-head hydraulic squeezer machines manufactured exclusively by Ph. Bonvillain & E. Ronceray 9-11 Rue des Envierges, Paris, France. These machines are in use in practically all civilized countries. They are specially designed for repetition work, and outputs as high as 400 molds a day have been cited. The author and THE FOUNDRY regret that the misstatement mentioned in the foregoing should have occurred.

J. L. Nellis, formerly with the Peterson Core Oil & Mfg. Co., has opened an office at 108 South La Salle street, Chicago, for the sale of foundry supplies and equipment. Mr. Nellis is a son of the late J. F. Nellis, for many years identified with the Charles C. Kawin Co., Chicago, and finds the foundry industry a congenial field.

Electric Furnace Improves Gray Iron

Sulphur Lowered by Treating Cupola Metal or Melting Direct on a Basic Bottom —Metal Superheated—Complete Charge of Turnings and Other Scrap May Be Used to Cheapen Mixture

BY DR. RICHARD MOLDENKE

FOUNDRYMEN are being directed to the application of the electric furnace from many quarters, and therefore will be interested in what an authority who has had such a wide experience as Dr. Moldenke, says about it. The views of the foundryman and metallurgist instead of the engineer are expressed to illustrate the benefits to be derived from electric melting and to sum up the costs of the process.

ONE of the gravest problems of the iron foundry today is the accumulation of sulphur in commercial scrap and its effect on the castings made therewith. The ordinary jobbing castings today show a sulphur content of 0.18 per cent, and occasionally as high as 0.22 per cent. The product of the foundry during the war is undoubtedly to blame for this rapid increase and conditions will become worse as the millions of tons of gray-iron castings of the war period return to the foundry in the form of commercial scrap.

In the ordinary cupola remelting pig iron and scrap, at least 0.02 per cent sulphur is taken up; often double that amount. The high cost and difficulty of obtaining pig iron during the war period compelled the use of considerable scrap in the mixtures; frequently charges containing 90 per cent of bought scrap were melted. Naturally the sulphur content of the castings increased.

Until the advent of the basic-hearth electric furnace, the only method of holding the sulphur within reasonable limits was to use high percentages of pig iron in the foundry mixtures. Pig iron seldom contains over 0.05 per cent sulphur, if well made. With pig iron forming 60 per cent of the charge and the gates, runners, rejections, and bought scrap the other 40 per cent, the sulphur content of the castings can easily be held down to 0.10 per cent. However, pig iron costs more than scrap even when melting loss differences are considered, hence as small a percentage as possible will be used.

More Sulphur Allowed

The recent advance in knowledge of rational melting and the consequent reduction in losses directly due to oxidation of the metal, has permitted the acceptance of castings with a much higher sulphur content than formerly. The steel industry also is seeking to determine how high sulphur may go with safety. In the iron foundry, there is the danger of a low cupola bed or an unduly retarded air-furnace heat, with the consequent raising of the freezing point of the metal and segregation effects resulting from high sulphur with insufficient manganese. Therefore, the iron foundryman must have a means of correcting his molten metal. The electric furnace, with a basic hearth, offers this opportunity.

Before the iron foundryman, particularly the producer of gray and malleable iron castings, can pour his molds safely, the molten metal must have a high degree of superheat, be thoroughly deoxidized, and reasonably low in sulphur. A foundryman will get these characteristics if he uses good materials and melts properly. The electric furnace will give a highly superheated metal that is thoroughly deoxidized, and a fine degree of desulphurization if the hearth is basic. If, for greater economy and to fit existing equipment conditions, the duplexing system—cupola metal refined in the electric furnace—is used, the best results for quality are obtainable conjointly with a reasonable cost.

The foundryman may melt cold metal directly in the acid or basic-hearth electric furnace, or he may refine molten cupola or furnace metal in an electric furnace with either of these hearths. In duplexing, however, it is not likely that open-hearth metal will be transferred to the electric furnace; in fact it is doubtful if even air-furnace iron will be used that way, as in the foundry the air furnace gives 10 to 40 tons of metal at one time, whereas the same tonnage from the cupola is either distributed over 2 to 4 hours, or spread over the entire working day. Therefore, the problem of the electric furnace in the foundry resolves itself into either adding the necessary electric equipment for duplexing, or installing electric furnaces for direct melting and refining cold stock. The basic process is to be preferred to the acid for its specific value in desulphurization.

When cold metal is charged into an electric furnace, unless carefully handled, there will be considerable fluctuations in the current until the pigs or pieces of scrap around the electrodes are melted. As the rest of the charge melts in the bath that forms, the fluctuations become less marked. Melting cold iron ordinarily requires a big current reserve and a higher current cost. Data from steel melting show that melting cold stock consumes up to four-fifths of the total current used, the refining period takes the other fifth. However, since refining is going on while melting progresses, the contrast in reality, is not so great. Duplexing is not only cheaper but it is also faster, for melting a cold charge and refining it in the electric furnace might take 2 hours, whereas the refining period after melting would not reach ¾ hour.

Electric Furnaces Expensive

The advantage of the melting-from-cold-metal system over duplexing lies in the ability to melt whenever desirable, whereas duplexing is dependent on the running time of the cupola. The higher cost of castings by either method, unless the lower grade materials used make up this difference, means that the electric furnace will only be used where quality work is produced. Thus, if the total cost of work is, say 3 cents a pound, it is not likely that the foundryman will add another ½ cent to ¾ cent; but for work that costs 15 cents a pound, this addition matters little. The maker of grate bars will undoubtedly stick to the cupola, whereas the producer of piston rings is already beginning to use the electric furnace.

Electric furnaces of large tonnage are expensive, a 3-ton outfit, which ordinarily would be considered quite large, costs about $35,000 at this writing. For a moderate degree of refining —that is superheating, deoxidation and desulphurization—the metal, as taken from the cupola, should remain in the electric furnace at least ½ hour. With

Paper presented at the February meeting of American Institute of Mining and Metallurgical Engineers held in New York, by Dr. Richard Moldenke, Watchung, N. J.

rapid repairs after tapping out, fully ¾ hour will be required for each batch of molten metal. For an average foundry, melting say 20 tons daily in a 54-inch cupola, the heat will last 2 hours, which permits the treatment of only half of it by the duplex method using a 3-ton furnace. Unless the product of the establishment can be divided into high-grade and ordinary work, the duplex process will be difficult to install with the present daily routine. Foundries can do this in most cases, hence an electric furnace equipment added to the ordinary foundry will work out nicely.

Where it is necessary that one casting will be as good as the next, the entire heat must be melted from cold stock or duplexed. As by using high sulphur pig irons, large percentages of low-grade scrap, briquettes of borings, punchings, shot, etc., it is possible to get from the electric furnace, when melting cold stock, as cheap a molten metal, fully refined, as from the cupola. Thus metal may be melted in the electric furnace without the use of the cupola and heats may be taken off all day long if desired. But unless a shop is run on the all-day pouring plan, the owners will hardly care to make the necessary changes in methods such a radical operating departure produces, unless accompanied by a complete shutdown during the transition arrangements.

Acid Hearth Requires Good Material

The selection of the basic-hearth electric furnace involves several considerations. In the acid-hearth furnace the slag situation is easier. Deoxidation is readily accomplished by providing a slag cover and adding periodically on this fine coke to hold the furnace atmosphere neutral. The intense heat of the bath, with its high carbon percentage, takes care of all oxygen that may be in the metal in some combination. The disadvantages of the acid-hearth furnace are that, whether melting cold metal or duplexing, it is necessary to start with comparatively good material, as the sulphur is not removed from the charge. Further, there is a marked addition of silicon in the bath by reduction from the silica hearth and slag, if refining is carried on for any length of time. The advantages of the acid-hearth are the cheaper refractories required, the furnace body lasting as long as an open-hearth furnace, and in much easier slagging conditions. Therefore, where the question of extremely low costs is not so serious an item, there is no reason why an acid-hearth electric furnace should not be used for melting from cold metal, for the sulphur can be held down by using high percentages of low-sulphur pig iron—the melting process gives no additional sulphur, as is the case in cupola melting.

In view of the sulphur conditions in purchased scrap and the desirability of holding down the sulphur maximum, the basic-hearth electric furnace should be used in every new installation, whether for cold melting or duplexing. Nothing prevents running an all-scrap heat through the cupola for ultimate refining in the basic-hearth electric furnace. The carbon conditions can be regulated in the cupola sufficiently, or if necessary in the electric furnace by steel scrap additions, if time can be given for this purpose. The silicon can be increased, if desired, by adding ferrosilicon, and such elements as nickel, chromium, titanium, etc., provided by direct or ferroalloy addition, or in the pig iron originally used. Phosphorus and manganese require further comment.

As the electric furnace for the foundry is intended to improve the molten metal only in regard to initial heat, freedom from oxygen in some combination, and elimination of sulphur to the desired minimum, the question of a possible phosphorus reduction does not come up. In fact, unless the steel stage is passed through this is out of the question anyhow. The iron foundry deals with three ranges in phosphorus. In the malleable casting the phosphorus must range from practically nothing to a maximum of 0.2 per cent. For gray iron the low range is anything under 0.3 per cent; actually it will be around 0.175 per cent. The general run of gray-iron castings have about 0.5 per cent phosphorus, the range being from 0.3 to 0.7 per cent. The high range is anything above 0.7 per cent and is confined to light castings of an ornamental nature, such as stoves and radiators. Foundrymen have no difficulty with their phosphorus, as it can be regulated by suitable purchasing of pig and scrap, steel scrap being practically free from phosphorus and stove-plate scrap containing large amounts of it.

Whenever the product of a foundry runs below 0.5 per cent in manganese, there must have been defects in the melting practice, involving undue oxidation during the operation, unless the mixture was too low in manganese in the first place. Where, with sufficient manganese in the mixture, the castings come out below 0.5 per cent either burnt scrap has been used or the bed of the cupola was too low and free oxygen from the blast attacked the melting iron. With thorough deoxidation and desulphurization effected in the basic-hearth electric furnace it is possible to start with lower manganese ranges in the mixtures*; indeed, it is necessary to start with lower manganese, otherwise that part of it in the mixture intended to care for excessive sulphur, were the castings made directly from cupola metal, will on desulphurization in the electric furnace remain behind and act as a hardening agent. One well known southern pig iron is so low in manganese that foundrymen fear to use it; yet, if properly melted, this iron yields excellent castings.

Reducing Atmosphere Desired

The metallurgical aspects of the basic-hearth electric furnace operation are interesting: To desulphurize rapidly and well, it is necessary to keep the lining in good shape and to charge lime with a little fluor spar to form an active slag on the molten metal. Crushed coke is also charged on the slag in order that the interior atmosphere may be kept either reducing or at least neutral. The more active the lime the quicker is the reduction of sulphur. Calcium carbide is formed and the bath is both deoxidized and desulphurized. A shallow bath is quicker than a deep one, for the greater the slag and metal contact area the better is the interaction. While it is possible to get the sulphur content as low as 0.009 per cent, * * this reduction is not necesary in ordinary practice. Reductions to 0.04 or 0.05 per cent are quite sufficient, for to go lower requires a rapidly increasingly proportional current and time consumption.

The matter of costs is a wide subject, for much depends on the furnace used. In the figures here given a fairly high average has been assumed. The chief item—cost of current—varies in localities. The present general rate is about 1.5 cents per kilowatt-hour; hence this figure has been used in the calculations. On a 3-ton basis, melting cold stock would require roughly 530 kilowatt-hour per ton. In duplexing it is possible to get along with 100 kilowatt-hours. This would mean a current charge of $7.95 and $1.50, respectively. However, to the latter figure, the cupola melting cost should be added for purposes of comparison. At present this costs at least $4 a ton; in normal times one-half of this amount would be considered high.

The cost of electrodes varies somewhat with the type of furnace. Where the construction allows air currents to enter the furnace body and pass out around the electrodes there is bound to be a heavy carbon consumption. So allowing 20 pounds of

*Pointed out by Geo. K. Elliott: *Trans.* Amer. Foundrymen's Assn. (1920).

**As quoted by Geo. K. Elliott, a pioneer in duplexing cast iron; also by W. G. Kranz.

electrode per ton for melting from cold stock (or at 8 cents a pound, $1.60 a ton) and 60 cents a ton for duplexing, this item would be covered. Refractories for repair purposes, including the periodic complete rebuilding of the furnace body, amount to 45 cents a ton for an acid-hearth electric furnace, and about $1.50 a ton for the basic system.

Labor for the melting from cold stock costs about $2.50 a ton, while with duplexing the cost is about $1.50—the labor of charging the raw materials going to the account of cupola melting. The subject of depreciation, interest, etc., when figured on the basis of 300 heats annually—or corresponding to duplexing conditions, will run about $2 a ton, on a 20 per cent basis on the investment. With continuous running, whether electric melting only or duplexing, and a consequent possibility of many more heats annually, this charge will be lowered materially.

Summarizing these costs per net ton gives the following:

	Cold-metal melting acid hearth	Duplexing basic hearth
Current	$7.95	$1.50
Electrodes	1.60	0.60
Refractories	0.45	1.50
Labor	2.50	1.50
Depreciation, etc.	2.00	2.00
	$14.50	$7.10
Adding cupola melting cost		4.00
		$11.10

If all the metal of a foundry is poured from the electric furnace, it is possible to effect a saving, in each of the foregoing cases, of practically the whole amount through the use of briquetted borings, steel, malleable, stove plate, and other scrap—to the exclusion of practically all pig iron—whether these are melted in the electric furnace or run through the cupola. If all foundrymen were to use the undesirable lines of scrap on the market, these would soon be sold on their metallic iron content and compete directly with pig iron. But now, with a good metallurgical laboratory, a foundry could accomplish much in the way of cost reduction where a basic-hearth electric furnace is available to reduce the sulphur contents.

Those who have observed the tapping of an electric furnace heat of cast iron will have noticed the extreme temperatures of the material. The metal is snow white, and when poured into the molds remains liquid for a long time. The basins draw down funnel-shaped eventually showing excellent feeding qualities on the part of the molten metal; and the castings are close-grained and apparently sound. Hence this kind of iron may be used for high-pressure valves and fittings and other important construction work. The molds must be made of unusually refractory sand and the partings should be clamped very tightly. The fluidity and length of time before solidification takes place make possible the cutting out of many risers and heads, and a reduction in volume of those necessary. This, with the smaller runner sections and the ability to flow long distances before showing signs of cold shuts, should make the subject an attractive one for those foundrymen who would be benefited by such valuable characteristics in their metal.

Quality Secured from Converter Process

BY H. F. McFARLIN

FOR THE past five years the use of the side-blow converter for the manufacture of small steel castings has been gradually decreasing. The writer feels that one of the strongest reasons responsible for this condition of affairs is the fact that so many steel foundries have installed converters and through improper management of the department and lack of understanding of the fundamental principles governing this process have condemned the converter. The general opinion seems to be that a man who can properly *blow* a heat is thoroughly qualified to act as foreman over a converter department, even though he may know little or nothing about the actual workings of the process. If a heat goes *wild*, if the steel is *blowey*, if the sulphur and phosphorus are abnormally high, it is usually deemed the fault of the process and the blame is never laid on the way the vessel was repaired, the condition of the tuyeres, the number of degrees at which the vessel was blowing or a dozen other points that all have a vital influence on the successful operation of this process. Again, if checks, misruns, etc., appear in castings of intricate design or with thin sections it is invariably blamed on the converter metal, when in the majority of cases the trouble can be traced directly to the molding method. On the other hand, how many converter operators consider the reactions that take place during the heat, or what effect they have on the metal. How many stop to consider the effects of a wild heat, that is, the abnormal loss in blowing, the damage to the lining, or the quality of the resulting metal which is nearly always higher in sulphur and phosphorus than it should be and is highly oxidized. How many realize what a properly aligned set of tuyeres means, and also the care which should be taken in setting the vessel before starting the heat? To start at the beginning of the operation: How much importance is attached to the melting of the iron in the cupola, uniformity of charging, etc.?

As those familiar with converter operations know, it is possible to get hotter steel in a shorter period of time with this process than with any other. It is also possible, with proper attention, to secure a grade of steel that will compare favorably with that made in the open hearth. This quality can also be greatly improved, by the use of purifiers, after the heat has been blown.

The great disadvantage of converter steel is the high sulphur content, and this can only be regulated by careful working of both cupola and converter, but even the sulphur content, unless abnormally high, is not such an objectionable feature if the steel is properly treated and close attention paid to detail. Some difference of opinion has recently been disclosed as to whether sulphur, within ordinary limits, is as injurious to steel as was formerly supposed. It is the writer's opinion that, at some future time, a higher sulphur content will not only be permissible, but methods will be devised whereby sulphur in certain percentages and compounded with other elements will be considered beneficial to steel.

When one considers the multitude of uses for small steel castings made by the converter process; the simplicity and cheapness of its installation in the ordinary foundry and the fluidity of converter metal for casting intricate shapes, it may be seen that the converter process, when properly handled, is still a highly satisfactory method for the production of small steel castings.

To Manufacture Furnaces

The Unit Stove & Range Co., Birmingham, Ala., which constructed a large stove works near the by-products plant of the Sloss-Sheffield Steel & Iron Co., a year ago and operated the plant at near capacity until the latter part of 1920, is installing complete apparatus and preparing to manufacture hot air furnaces.

Proved Design for Ladle Stopper

Means Is Provided for Taking Care of Expansion of Sleeve—Simplicity of Operation and Assurance of a Tight Connection Are Achieved —Taper of Bottom Sleeve for Acid Practice

STOPPER rods similar to that detailed in the accompanying illustrations have been used for several years at a number of foundries with success. The advantages of this stopper rod arrangement, including the mechanism for attaching it to the ladle, are its simplicity and freedom of operation. With a slight pressure exerted on the lever the stopper rod will move up and down easily, its motion being guided by a grooved slide. There is never any trouble with binding in the slide and guide. The stopper arm allows careful adjustment of the stopper rod when setting the stopper. The fit between the stopper and the bottom sleeve is such that it is not possible for the metal to work between them and burn off the stopper-rod pin. The method of keying the stopper to the stopper rod probably is the simplest and best known.

LEAKY ladle stoppers are a serious matter in a steel foundry, for it is necessary to have perfect control of the metal when pouring a mold. For this reason the design of a stopper which has proved adequate in service is of value to the steel furnaceman. The detailed drawings here presented, show a ladle stopper with the mechanism for connecting it with the ladle, which has been standardized and is used with satisfaction by a number of steel foundries. These details were furnished by the Machined Steel Casting Co., Alliance, O.

It may be noted by referring to Fig. 1 that the bottom sleeve has a pronounced taper from the bottom to the top, and that the top sleeves are small in diameter. This is possible with acid practice, but with basic practice the sleeves should be 1 inch larger in diameter, which makes the bottom sleeve more nearly straight at the sides. This is because basic slag attacks the refractory of the sleeve much more actively than does acid slag.

After setting the stopper rod the nut shown at *A* in Fig. 2 should be backed off to allow about ½-inch clearance,

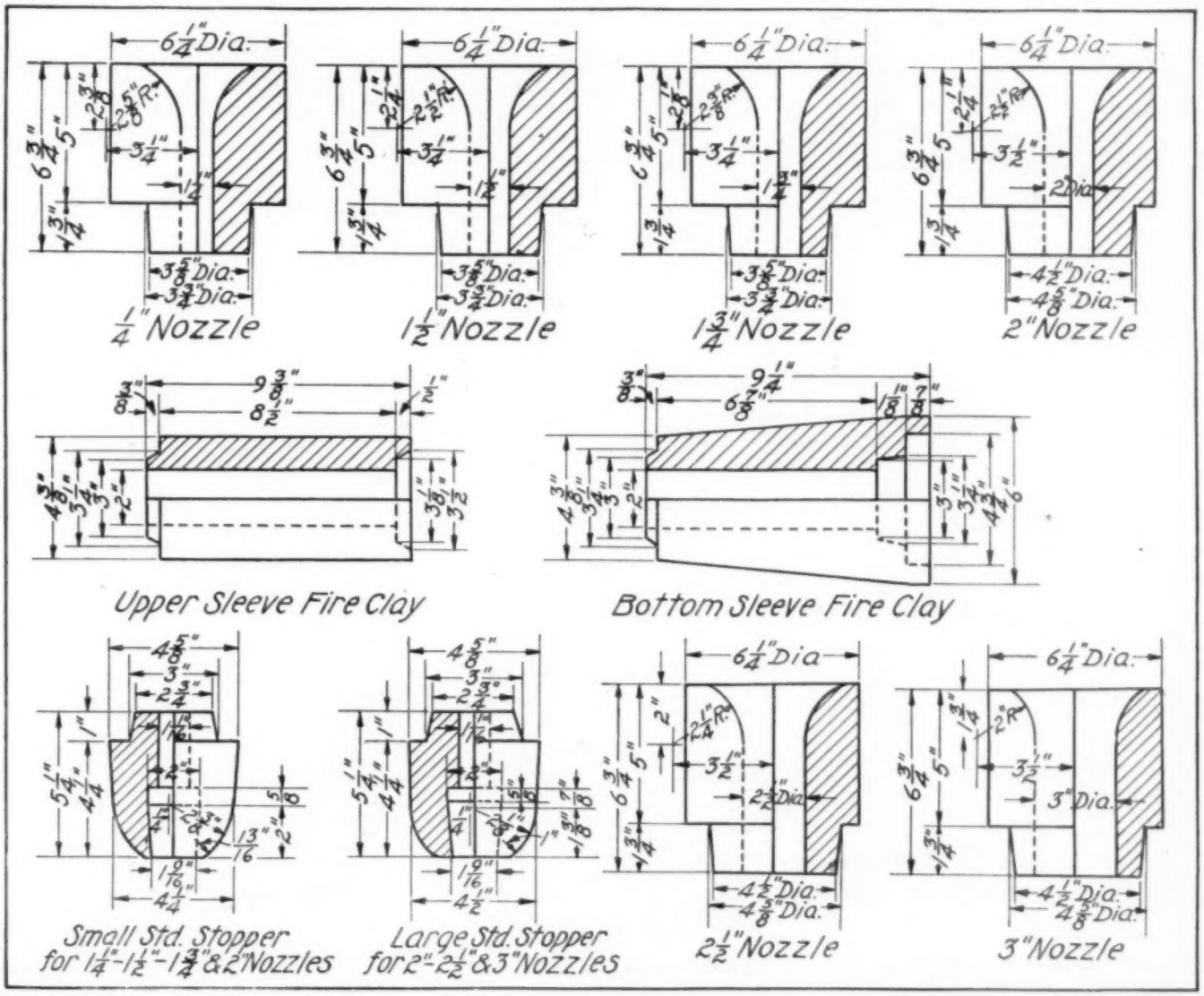


FIG. 1—DESIGN OF STOPPERS, NOZZLES AND SLEEVES—NOTE THAT THE BOTTOM SLEEVE TAPERS FROM THE BOTTOM TO THE TOP—FOR BASIC STEEL A SLEEVE 1 INCH LARGER IN DIAMETER IS REQUIRED

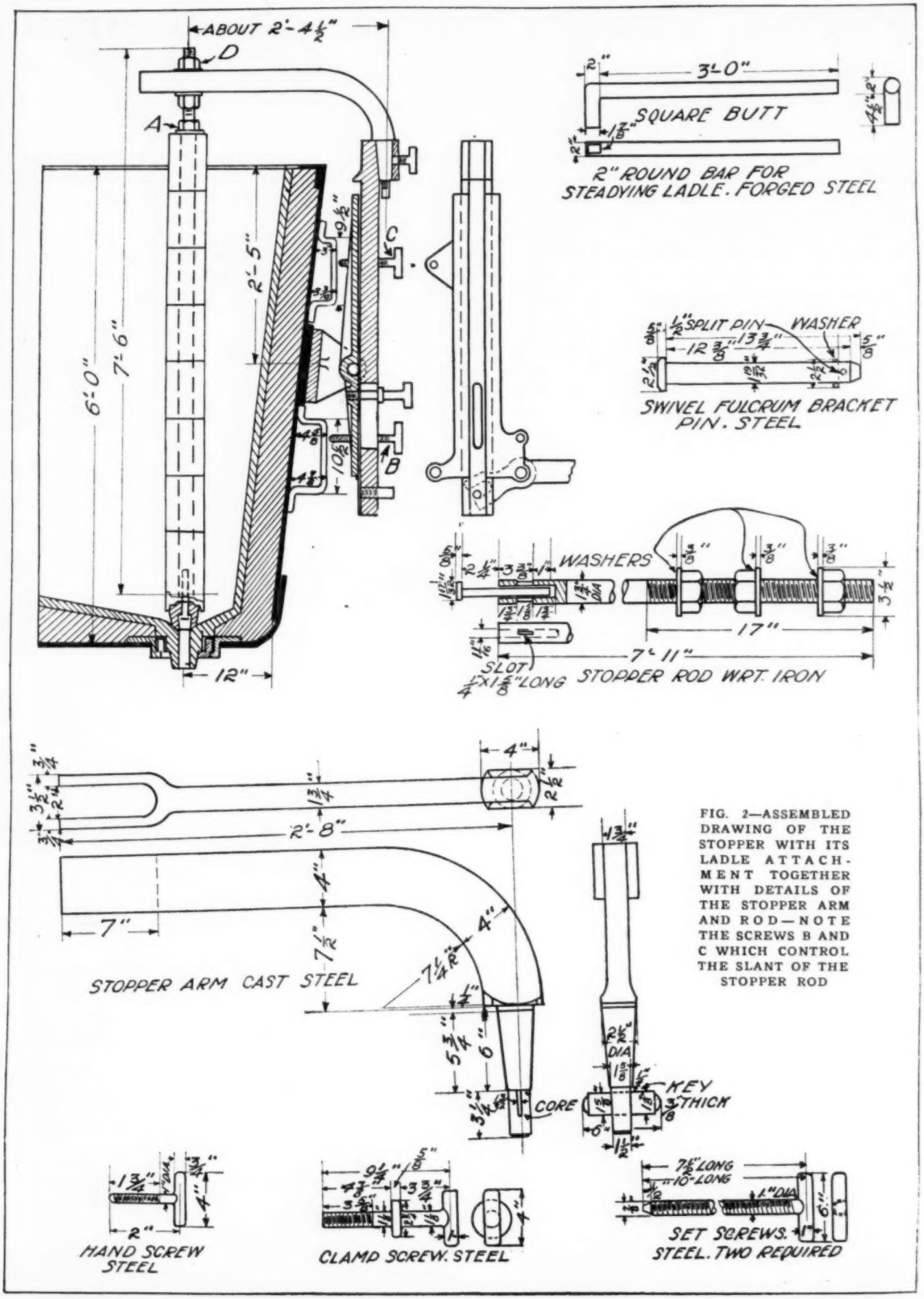


FIG. 2—ASSEMBLED DRAWING OF THE STOPPER WITH ITS LADLE ATTACHMENT TOGETHER WITH DETAILS OF THE STOPPER ARM AND ROD—NOTE THE SCREWS B AND C WHICH CONTROL THE SLANT OF THE STOPPER ROD

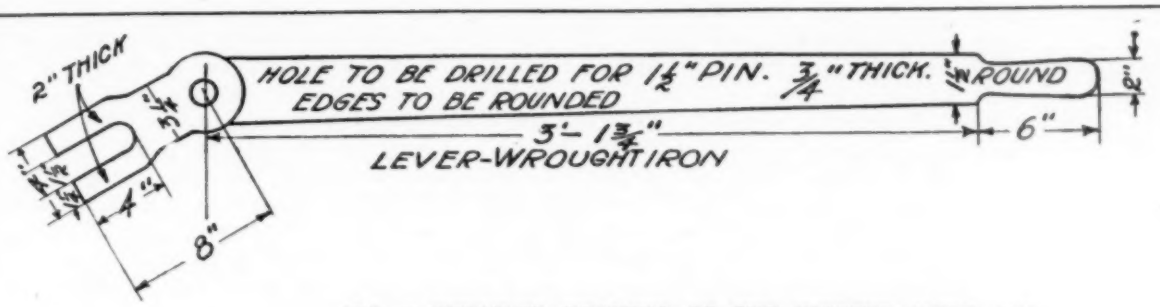
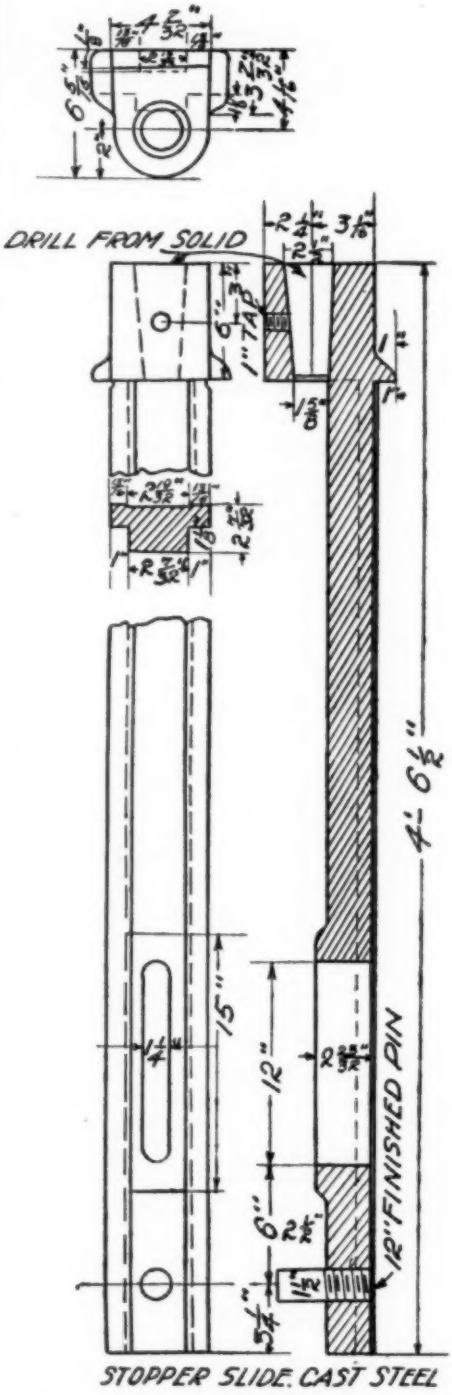
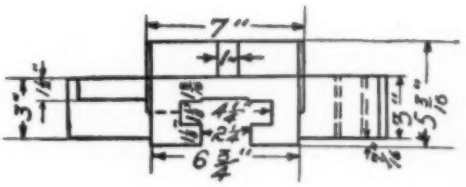
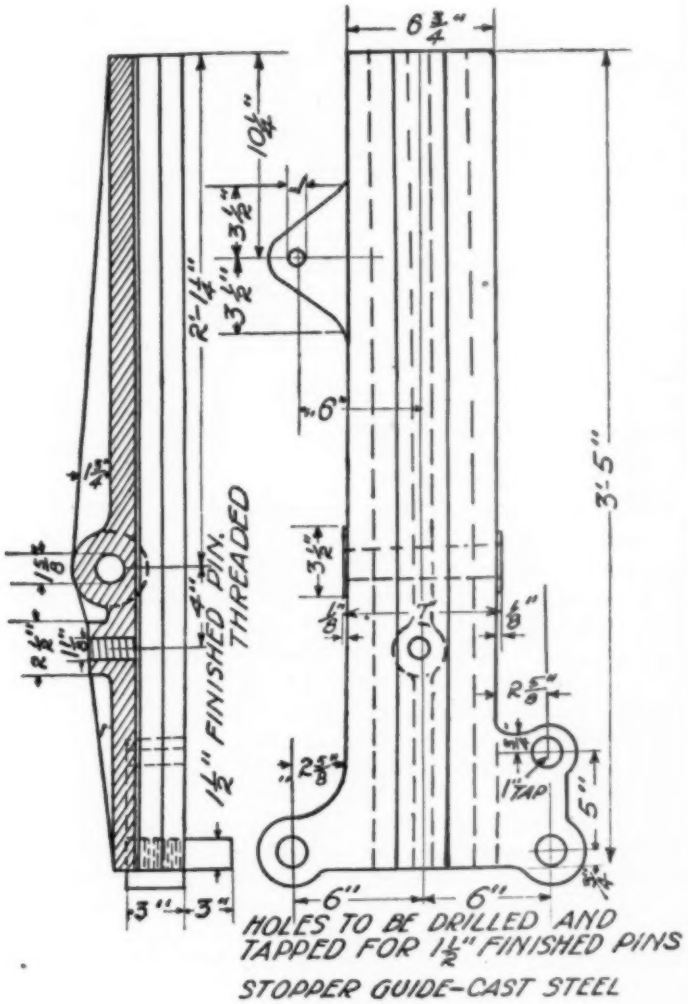


FIG. 3—DETAILED DRAWING OF THE STOPPER SLIDE AND GUIDE AS WELL AS OF THE WROUGHT IRON LEVER—THE STOPPER IS EASILY RAISED OR LOWERED BY THE LONG LEVER AND THE SLIDE MOVES READILY ON THE GUIDE







for the following reasons: By careful experiments it has been found that an individual sleeve 9⅜ inches long expands about 3/32-inch when heated by the molten steel. The entire length of sleeve on the stopper rod, which is about 81 inches, expands ⅞ to 1 inch during the pouring of a heat. This maximum expansion is reached quickly, that is, the expansion of the sleeve is much faster than the expansion of the rod. The expansion of a stopper rod of the same length will be about 1⅛-inch on an average, and the maximum expansion is reached when the rod reaches a temperature of about 2000 degrees Fahr. This is about 45 minutes after the heat is tapped into the ladle.

Experiments have shown that immediately after the heat is in the ladle the sleeves take up the ½-inch clearance. They then are practically tight against the nut and remain so for about 10 minutes. After this, due to the expansion of the rod, the clearance gradually increases as shown by experiment, so that 11 minutes after the sleeve becomes tight against the nut there is 1/16-inch clearance, 12 minutes later there is 1/8-inch clearance, and 8 minutes later the clearance has increased to ½-inch which it remains until the heat is completely poured. It may be seen from this that if the nut were not backed off at all, the stopper head would probably be broken off the rod with serious consequences, due to the quick expansion of the sleeve. If the nut were not backed off far enough there still might be enough pressure, due to the quick expansion of the sleeves, to break off the stopper head, so that the backing off of the nut about ½-inch is a most necessary part of the ladle practice. This should be done by the ladleman when he sets the stopper ready for receiving the steel in the ladle.

The set of the stopper should be tested in the usual manner, by throwing sharp sand around it. If no sand leaks through it will be a sure indication that the stopper will hold the steel. The slope of the rod is controlled by the two screws *B* and *C*, Fig. 1. The distance the rod extends in towards the center of the ladle is changed by unloosening the nut *D*, Fig. 1, when a slight jar with a hammer or wrench will move the stopper.

Cast Iron Research in Great Britain

VARIOUS aspects of the cast-iron research problem were discussed at a joint meeting in Birmingham, England, Feb. 3, of the British Cast Iron Research association and the Birmingham branch of the Institution of British Foundrymen. J. G. Pearce, Metropolitan-Vickers Co., Manchester, formerly the British Westinghouse Co., was the principal speaker. Prof. Thomas Turner of Birmingham university, presided.

Mr. Pearce explained the organization of the Resarch association, which has been created to investigate problems in cast iron for the benefit of the British foundry industry as a whole. The association operates under government auspices and receives grants of government funds. In the wider field of general cast-iron research this British association is not unlike the American Malleable Castings association.

Dealing with the subject of research in the foundry in a general way Mr. Pearce said in part:

"Theory and pratice are two aspects of the same thing. Every art or craft has a scientific basis—because it has a technique of its own, a method, it employs materials, and is susceptible to improvement. The examination of the means whereby this improvement can be effected constitutes research. Great Britain is behind both America and Germany in applied research.

"Of course the results of scientfic research cannot be fully realized in industry without the fullest co-operation of the workmen in the industry. Progress means change and without the willingness to change on the part of workers progressive measures cannot be undertaken. Generally speaking a workman is not antagonistic to change provided it can be shown that he will not suffer as a consequence of it. He will welcome it enthusiastically if he benefits by it. The process of indicating that workers benefit by improvements wrought by science is necessarily educational and there is no body in the industry so competent to undertake this as a research association."

Would Admit Labor Unions

Commenting on the foregoing Mr. Pearce made the rather unsual sugestion that representatives of organized labor should sit as members of the council of the Research association. Then turning to the purely scientific aspects of foundry research he said in part:

"The Research association will naturally be greatly concerned with the materials and processes of the castings industry with a view to their standardization and improvement, and the determination of the best way in which foundry processes may be conducted. The question of the recovery of scrap and waste will become of increasing importance.

"There are many types of castings which do not call for particular improvement in weight or quality, but those intended for the engineering industries offer enormous opportunities in this direction. The development of increased speeds in rotating machinery continually necessitates better and better materials even though they are not actually in the rotating part itself. Huge quantities of castings are exported either as castings or after assembly with other parts into machines. Diminution of weight would in the aggregate make big differences in transportation costs and diminution in cost would greatly assist export trade.

"There has been a steady tendency in recent years to replace cast iron in engines and turbines by steel or nonferrous metals. The proportion of nonferrous metals in such machines has been doubled within a comparatively short time. It is specially significant that the nonferrous metals are introduced when the service conditions are espesially severe or where corrosion is most to be feared, as in naval vessels, particularly submarines. This can only be overcome by a thoroughly scientific study of cast-iron, the cheapness of which gives it otherwise a considerable advantage.

"Scientific research is perhaps even more necessary in ironfounding than in any other industry. But epoch making results cannot be commanded. The research worker is an explorer, groping about beyond the limits of the paths made by previous travelers. He may have ideas about where the path is, he may speculate and surmise but he does not know. He cannot say to himself, I will discover this, that or the other thing'; he has to go on in trust and in faith. He may spend his whole life working and discover nothing of commercial value, but he will record his work so that others will not duplicate it. He may appear to strike something by a lucky accident, but accidents only happen to men of long training experience and inventive genius. Research is like digging in a mine. A prospector is almost sure to find something of value, and he may strike a vein of great richness and value, but the expert eye is required to indicate just where the labor may most profitably be expended."

How to Get Back to Normal Quickly-II

Method for Analysis Suggested in Previous Article Furnishes Basis for Intelligent Wage Adjustment and a Sound Argument for the Extension of Credit

BY C. E. KNOEPPEL

THE seven principals enumerated in the previous installment of this article, constitute the mechanism of getting back to normal quickly. The question now arises, how are we to get workmen interested in helping; how are we to induce our bankers to assist us financially; and what must we do to induce the consumers to purchase goods?

If workmen can see a scientific basis for loss-taking; if it can be demonstrated to them that anticipating normal will reduce unemployment, making drastic wage cuts unnecessary, and can stimulate buying, they will be quick to agree to do what they can to attain fair standards attainable for the various operations and even accept a reasonable cut in wages if necessary.

You would say to them:

"These charts show that to get back to normal we expect to lose so much. Now to get back to normal it will be as necessary for you to produce normal outputs as for us to quote normal prices. If you don't, our losses will be that much more, and may seriously affect our ability to keep going. You may feel that this is none of your concern, because you may say that if you don't work for us you can work for someone else. But the fact remains that any business condition which adversely affects us is likely to affect other concerns in greater or less degree. Therefore, isn't it better for us to get together, we 'playing the market short,' and you giving us the safely attainable productions necessary to keep us within definite cost limits at wages consistent with the cost of living which these conditions would bring about? In this way we can work things out and keep going."

This leads, then, to the eighth principle of getting back to normal quickly:

8—*Call in some of your best workers, as representatives of their fellow workmen; outline to them what your present conditions are and what you want to do. Explain to them the above principles as they relate to unemployment, reductions in hours and wages, and what losses to the company will mean to both workers and the company.*

As to the bankers, it is well-known that money goes to that establishment which can demonstrate that it is safely and wisely managed. Many financial houses today are uncertain whether to call loans or to extend them; whether to help, in the expectation of assisting in pulling things through and thereby safeguarding their investments, or to quit and pocket their losses.

Go to your banker and say:

"Here is what I am doing now. Here is what I did at full capacity, and here is what I can do at normal. If I continue as at present, I may win and I may go under; if I can get back to normal quickly, I will lose much less and can pull through successfully. Here are the facts and the figures."

Are not the bankers looking for just such kind of talk? The most conservative banker in the country knows that his task is to differentiate between what is guesswork and unsystematic procedure, and what is definite, provable and likely to happen. He will be the last one to turn down a request for money on extension of loans when he knows that it is based on the same fundamental he relies upon to make decisions coordinated knowledge.

This, then, gives the ninth principle of getting back to normal quickly:

9—*Place plans as to normal possibilities, with full explanations, before bankers as a basis for credits and financial assistance.*

With a campaign based on normal capacity worked out; with negotiations going on with workers to get their help in producing up to safe working maximums, and with bankers to render financial support, you then are in position to give proper attention to sales and advertising campaigns; to consider what you can do in the way of time payments, discounts, deliveries, quality betterments, and other things as a basis for booking orders, which will mean reaching normal quickly.

This gives the basis for the tenth principle of getting back to normal quickly:

10—*Plan the sales and advertising campaigns necessary to secure prices which reflect normal operating conditions.*

Where The Trouble Lies

The trouble today is not over-production, *it is underconsumption.* The world needs the products of industry, now, not next year. A national campaign, based on practical plans for getting back to normal quickly, will do more to place industry on a firm footing than any other one thing, because the basis would be coordination, based on positive and accurate knowledge, between banker, worker, salesman and executive.

If the newspapers, magazines, advertising clubs and advertising agencies of the country, would really get behind the kind of plans outlined, it would mean a nation-wide publicity campaign which would directly benefit all.

In short, the steps are:

1—Determine normal capacities
2—Standardize the expenses of doing business
3—Determine fair standards of performance by workers
4—Determine quantity of goods which can be made
5—Estimate the cost of normal productions
6—Determine prices at normal profits
7—Hold losses between standard and actual overheads for the year in an adjustment account
8—Explain plans to workers
9—Explain plans to bankers
10—Plan selling and advertising campaigns.

Naturally you are interested in the practical possibilities of the procedure. What has been outlined is not mere theory. Each principle has been used in some case at some time, although this is the first known attempt to bring them all together in a co-ordinated way. Let me give you a practical example of the utility of the recommendations made. In the early part of 1908, work was started in a large plant in Pennsylvania, comprising a structural shop, machine shop and foundry. At the time the methods were introduced, the business was making little money. Its sales were not large. It was a heavy borrower, with a pattern account far in excess of its real value. It had a bond issue pending. The radical, and from the accounting standpoint, the revolutionary thing about the development, at that time, was the adoption of standard burden rates for the various departments, the work-in-process being charged with standard, and the differences between the standard and actual being charged or credited monthly to a departmental burden profit and loss account. Comparing an eight-year subsequent average with a four-year average previous to starting the methods, the results were a 12 per cent yearly profit on capitalization for the eight years; as against a two per cent loss on cap-

italization for the four years; the reduction in quick liabilities for the eight years was 90 per cent as against 6 per cent for the four years; while the reserve and surplus was increased from 14 per cent for the four years to 72 per cent for the eight years.

Looking at results in another way, reduction in borrowed money, for the eight years, amounted to 60 per cent of the capitalization; additions to plant amounted to 42 per cent of the capitalization; while the dividends amounted to 30 per cent of the capitalization.

Has Been Successful

A manufacturing concern in Hoboken; New Jersey, wrote under date of January 28th as follows:

"It readily can be seen that this plan is beneficial to our customers as well as ourselves; whereas, if this program had not been applied, a total shutdown would have been necessary."

People have said, where is the money to come from, with which to buy products? My answer is this:

Products are wealth; production creates buying power. The only limit on ability to acquire wealth is the ability to produce it. We can only have more riches by producing more goods or buying power.

Obviously, if I am a farmer, I cannot buy more horses, or cows, or sheep, by producing less pigs, less milk, or less wheat, or other products. In other words, if we are going to exchange for more, we all must produce more, not by spurts, but on a normal basis throughout the year.

Another question comes up, how are we going to reconcile finance, labor and management? My answer here is that we must all fall back on a fundamental principle.

Let each interested party take less than he now demands, in order to get more than he now " has."

Should not this principle he sold to workers, bankers and executives, by showing them how the realization of 100 per cent demands on the part of each affects the receiving of things from others, as well as their ability to give them? No one is opposed to selfishness of conflicting interests, so long as this selfishness is intelligent.

Probable Price Tendencies

The Liberty national bank New York has published a chart of price tendencies. This shows that it took nineteen years, following the outbreak of the Civil war, before prices reached the 1860 level. The 1867 and 1920 price points are together on the chart. It is extremely doubtful, of course, if it will take us twelve more years before prices are down to pre-war basis, as conditions now and at the time following the Civil war are much different. The bank statement says.

"Whether the future price trend will follow the Civil War precedent, or depart from it, this much is to be observed, that the contention that we must expect a permanently higher price level has been rudely shaken during the last few months."

The National City bank *Review* says:

"Adjusting relations between groups of producers so that a full exchange and consumption of products can go on, is the objective of the wage question."

Of interest to every man, woman and child in this country today, in fact all over the world, is the matter of how to get back to normal quickly.

We are afraid to buy because we do not know what is coming, or because we expect prices to go lower. We are afraid to produce because we do not know how much buying there may be. We are afraid to invest or loan, not knowing what may happen to our money. Workers are afraid to cut loose and produce, for fear this might bring greater unemployment all the sooner.

Buck Ague Prevalent

The business world is going around in circles, and is affected with an excellent case of cold-feet. We hear, on all sides, that by next month, or in the spring, or summer, or fall, things will be better. This attitude, however, will not in itself bring an upward trend a single day sooner. Yet there is no doubt as regards the urgent need for the products of industry.

The present situation easily can become worse unless vision, supported by facts and courage to take the initiative, are substituted for the fears and pessismism which are at the bottom of our industrial ills.

What is borrowing but anticipating the future? What is building a plant and installing equipment but anticipating the future? What is investing in a patent but anticipating the future? What is hiring an executive but anticipating the future? What is an expenditure in an advertising campaign but anticipating the future?

Should we anticipate on the basis of maximum results at all times? This would be dangerous. Should we anticipate on the basis of minimum returns at all times? This would be even more dangerous. Therefore, is there not, a reasonable certainty that if we anticipate on the basis of normal returns, we will more often realize our desires? After all, a normal is some mean between a maximum and a minimum.

Getting back to normal requires, first of all, a normal thinking; it next requires facts which reflect normal conditions; it then demands a willingness to anticipate normal results, which will mean normal results much more quickly.

My message in a nutshell is:

Supply the products which the world badly needs, by determining normal requirements, normal capacities, normal productions, normal costs, normal profits, and normal prices, and using them as a basis for conducting your business. In so doing, you will decrease unemployment and idleness in plants and equipment, and avoid drastic wage cuts.

Revise Safety Code for Grinding Wheels

The grinding wheel safety code, which was adopted a few years ago by practically all manufacturers of grinding wheels in the United States and Canada, will be revised in the near future. A committee, representing the various organizations interested in the code, is holding meetings at monthly intervals and will continue to do so until the new code is ready for publication.

Dr. L. W. Chaney, of the United States bureau of statistics is chairman of the committee while Alphonse Rousseau, of the Norton Co., Worcester, Mass., who represents the Grinding Wheel Manufacturers' association of the United States and Canada, has been appointed secretary. The following organizations are represented on the committee:

The International Association of Industrial Accident Boards and Commissions, the Grinding Wheel Manufacturers' association of the United States and Canada, the National Machine Tool Builders' association, the American Foundrymen's association, the National Founders' association, the National Metal Trades association, the National Association of Mutual Casualty Companies, the National Workingmen's Compensation Service bureau, the National Safety council, the United States bureau of standards, the United States public health service, the American Society of Mechanical Engineers, the Society of Automotive Engineers and a number of individual consumers of grinding wheels.

The committee was organized and the work is being carried on according to the rules of procedure of the American engineering standards committee. The completed code will be approved by the American standards committee to be known as the *American Standard.*

Correcting Flaws in Metals and Mixes

Problems of the Gray-Iron, Malleable and Steel Foundry Discussed

By H. E. Diller

Prevent Piston Castings from Cracking

Question—A large percentage of the piston castings made by us develop small cracks in the lip during the machining operation. So far as we can see it is due to the heavy gudgeon pin bosses on the sides of the pistons, which cause cooling strains in them. The section of the machined piston is $\frac{1}{16}$ inch. Please tell us how to remedy the difficulty.

Answer—If the cracks are caused by internal strains the difficulty may be remedied by annealing the pistons for several hours at 500 or 550 degrees Cent. This would relieve the internal strains and also would be a benefit in preventing the pistons from becoming slightly eccentric after being machined. It is possible that the cracks are due to the core being too hard and not crushing easily as the metal cools. This point should be looked into and a softer core tried.

Function and Application of Skim Gates

Question—I frequently see in the advertising pages of THE FOUNDRY illustrations of skim gates. These appear to be perforated pieces of sheet metal. I also see in molds shown in advertisements of molding machines, what appear to me to be perforated cores. Are these used for skimming purposes? It has been impossible for me to find out anything about either of these two devices in my country. Will you please tell me how they are used and where inserted?

Answer.—The metal skim gates are perforated pieces of sheet iron which have been tin plated. This tin plating prevents oxidation and gives a metal free from rust. The skim gates are places directly over the pouring gate. When metal is poured into the pouring basin and runs over to the gate, this skimmer holds it for a moment until the metal in the basin has a chance to rise somewhat. This causes a pool to form in the basin and the slag in the iron can come to the top of this pool and will therefore not flow through the bath.

The perforated core which you have noticed acts as a skim gate and it also breaks the full flow of the metal which might cause a wash in the mold. Both the metal skim gate and the perforated core are used in the same mold and frequently a number of perforated cores are used at different places in the runners of the same casting. Such gates are used on medium to light work in which it is essential that no particles of slag or dirt get into the casting. An illustration of this is the casting for an automobile cylinder. Such a casting is usually made in green sand mold with dry sand cores.

Produce Detail in Castings

Question—Cast iron medals have been made which show a fine reproduction of detail. Please tell us what is the best composition of metal for this purpose and the molding methods which should be employed.

Answer—Metal for giving a clear reproduction of details should be comparatively soft and exceedingly fluid at pouring temperature. The quality of softness can be obtained by keeping the silicon contents between 2.25 and 2.50 per cent. Fluidity is secured by high phosphorus contents. The phosphorus should range from 1.0 to 1.2 per cent. Sulphur should be kept moderately low and should not average much above 0.10 per cent. Manganese may be as low as 0.50 or as high as 0.90 per cent.

The molds for these castings are made with a fine sand. After the pattern is withdrawn the mold is dusted with plumbago. The pattern is then placed back into the mold and pressed down to smooth the graphite which has been dusted on the mold.

Amounts Too Small for Cupola

Question—We have to make a large number of molds for glass bottle machines. At present we make them from crucible-melted cast iron. We will cast 200 to 300 pounds of metal a day. Would it be possible to make these castings from cupola metal?

Answer—Practically any iron casting can be made from cupola metal. However, it generally would not be considered practical to melt only 200 to 300 pounds of metal in a cupola, especially when you are in the custom of melting it in the crucible and have the equipment for doing this. It would be better for you to continue to melt the iron in crucibles until you have a larger output. As a cupola lined to 24 inches in diameter will melt as much as one ton of iron an hour you can see how short a time would be required to melt 200 to 300 pounds. In melting this small amount the coke bed would have to be just as high as though a large tonnage was to be melted and the melting loss through oxidation would be larger. These two items would run up the cost of melting and besides this you would be likely to get a somewhat inferior metal which would tend to make the percentage of lost castings higher.

In case you decide to use a cupola the stack should be lined to 18 inches in diameter. For such a cupola the pigs should be broken so that no piece is longer than 12 inches. Before operating the cupola you should visit some foundries in your country which are using cupolas, and you will be able to learn many practical points from them.

Combining Malleable and Gray-Iron Work

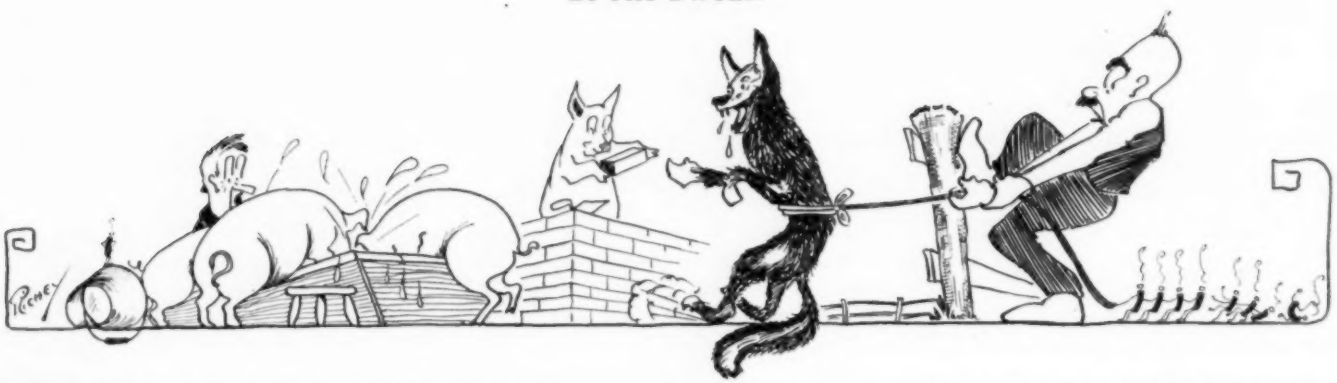
Question—Would you consider it practicable to combine a gray-iron and a malleable iron foundry in one plant and would a small malleable foundry with a capacity of 10 tons of castings a day be profitable?

Answer—A gray-iron and a malleable-iron foundry could be combined under one superintendent if he has a broad foundry and executive experience. They might also be combined in one building if the building were properly designed. In fact, in Europe the two are frequently operated in the same building. However, this presents difficulties and confusion, so, as a general thing, it would be better to have two separate buildings for the foundries. But there is no reason why a company should not operate both gray-iron and malleable foundries in separate buildings in the same grounds or plant.

Under certain conditions a malleable foundry with an output of 10 tons of castings a day could be made profitable, in fact, there are foundries operating with less than this output. However, it is generally considered that a daily average of 15 tons of castings should be made to make a malleable-iron foundry profitable.

Bill Reviews the Sheave Wheel Problem-I

BY PAT DWYER



FAR be it from me, an humble private in the ranks to question the motives or impugn the judgment displayed by that genial old be-whiskered saint who every year harnesses up his team of prancing reindeer and leaves his home under the shimmering glare of the far flung northern streamers to distribute gifts to the children of men. I suppose it shows an unappreciative spirit, but I sometimes am tempted to wish that he was forced to linger around for a few weeks and note the harrowing effects produced on innocent parties by some of his gifts, particularly illustrated story books for children.

He dropped one of these publications down the chimney of my humble cot some time during the dark hours of Christmas Eve. It was addressed to a young person not yet of school age who infests the premises at night and at meal times but whose whereabouts for the remainder of the day remain of profound mystery and a source of continual worry to his mother.

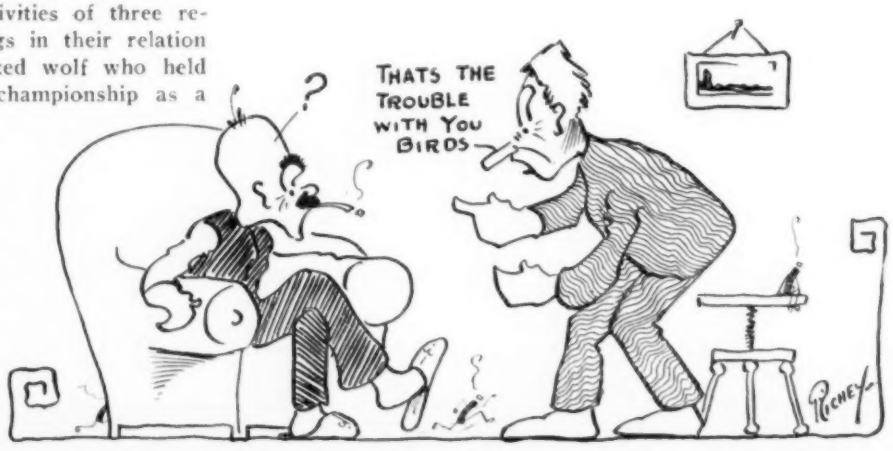
Every night after supper he brings out the book, climbs up on my knee and with every manifestation of conferring a favor gravely informs me that he will grant me the privilege of reading a particular story aloud for his benefit. The story in question is descriptive of the activities of three remarkable young pigs in their relation with a certain wicked wolf who held the long distance championship as a huffer and puffer. The pages have long since been torn at the edges and generously smeared with the imprints of little sooty fingers so that in places it is impossible to decipher the text, but he has heard the story so often that if I skip a sentence, nay a word or even an exclamation point, he promptly holds up traffic until the mistake has been rectified. No one is going to put anything over on him.

I was engaged the other night for possibly the 746th time in reading over this thrilling narrative when Bill came in and cocked his long ears in a listening attitude. The young man asked him if he ever had heard the story and Bill gravely informed him that he was perfectly familiar with the circumstances. In fact he had known the little pigs intimately and while he also knew all about the wolf, he had never cultivated his acquaintance or tried to get on speaking terms with him. The boy immediately transferred himself and his allegiance to Bill and the latter regaled him with a hundred little intimate details of the pig's daily lives which had been omitted in the original biography.

The lady who claims a half interest in the boy finally pried them apart and sent the little fellow off to bed, but not until Bill solemnly had promised to continue his recital on the occasion of his next visit. After he had gone I said to Bill that I wished I had thought of his scheme several weeks ago. I certainly had grown tired of reading the same story over and over again.

"That's the trouble with you," said he. "You have no imagination. You get in a rut and you stay there. You think there is only way to do a thing, while if you were to shake the cobwebs out of your mind you probably would find a dozen ways and derive some pleasure from your work. I don't know whether it is owing to laziness or some other reason but I have noticed that the majority of men either stop or slow down in learning after they grow up. Some of them stop at twenty, some at thirty and others reach forty, but they all fall sooner or later and when they fall they are like Humpty-Dumpty.

"Historians tell us that the ships of the Spanish Armada were wrecked on the south and west coast of Ireland and it is entirely probable that some of my remote ancestors may have been Spanish gypsies from Arragon or Castile or from the Basque provinces. Whatever the reason, I certainly detest monotony and welcome any changes that come in my way. In fact, if the changes for any reason are reluctant in manifesting themselves I welcome the opportunity of seeking them in their lair. I may not be a gay, dashing young blade, but at the same time I am not an old man and I expect to learn a great many things before the undertaker, or to give him his modern official title, the funeral director, gets his hooks on me. For instance consider the many methods in vogue for molding sheave wheels



THERE ARE NONE SO BLIND AS THOSE WHO WON'T SEE

"In my own practice I have made molds in 10 different ways for producing this type of casting and I should not be surprised at all to find that ingenious members of the craft have developed as many more. Personally, I cannot imagine an eleventh method, but that is different altogether from saying that such a thing is impossible. I have known molders who only knew of one way to make a sheave wheel and they really thought that was the only way in which it could be done."

I told Bill that I had made a few sheave wheels in my time in various parts of the country and I always had been given to understand that there were only seven possible methods by which they could be molded. In fact only three, or at most four methods were practiced to any extent and the comparatively few men who could boast that they were familiar with the entire seven methods were regarded as thirty-third degree members of the craft.

"Well," said Bill, "I'll tell you. The molder who knows seven different ways to make a sheave wheel has a fair working knowledge of the trade, but that does not mean that he is perfect or that he is qualified to pass over the burning sands of the desert without a guide. The shape and size of the casting and sometimes the number ordered, usually are the determining factors in deciding which is the best method and rigging to adopt for making a sheave wheel. Each method has its advantages and its disadvantages. Some are only possible in the case of plain web sheaves of small diameter; others are adapted to sheaves either with arms or webs. At least two methods are applicable in emergency cases where it is necessary to employ an old casting for a pattern. One method is shown merely as a curiosity, illustrating how a green sand mold may be manipulated in the hands of a skillful molder. The remaining methods are those ordinarily employed in every day foundry practice.

"In the language of that class of accomplished gentlemen whom we cheerfully pay 45 cents with an added 5 cents for war tax, to see perform; 'If you kindly will give me your undivided attention for a few minutes, ladies and gentlemen, I will endeavor to demonstrate for your benefit the 10 different methods for making sheaves practiced

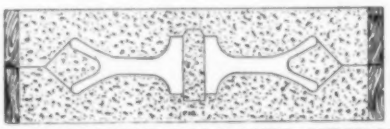


FIG. 1—DOUBLE ROLL-OVER METHOD

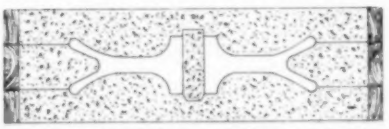


FIG. 2—USING A 3-PART FLASK

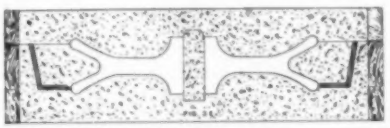


FIG. 3—ILLUSTRATING USE OF THE LIFTING RING

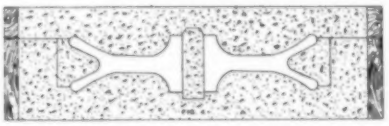


FIG. 4—GROOVE MADE WITH A DRY SAND CORE

by those hardy and skilled artizans who spend the most of their lives creeping around like moles in the murk and gloom of the average foundry.'"

I interrupted Bill at this point to say that I could not see either the necessity or propriety of introducing this vaudeville stuff. If he wished to talk about serious foundry problems I should be pleased to listen, but if he intended to turn the thing into a low comedy sketch he could count me out.

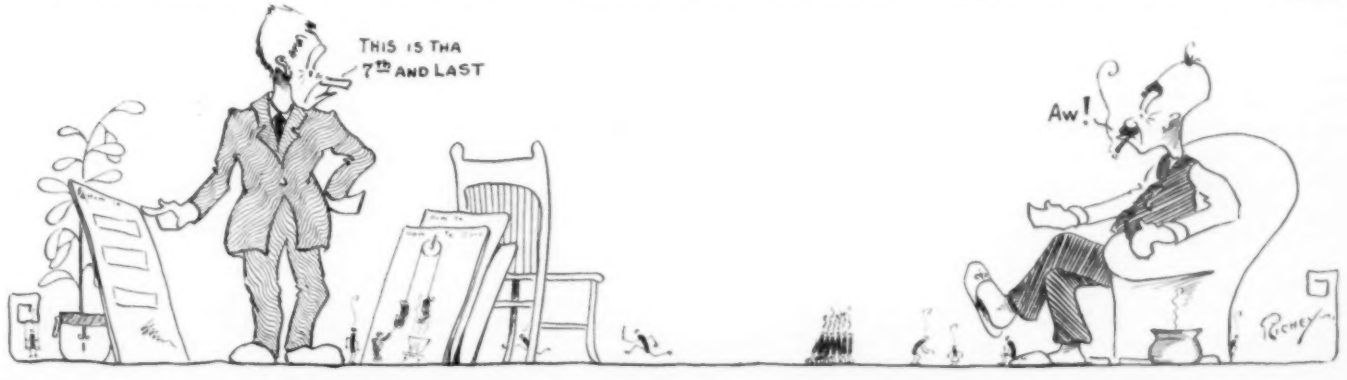
"All right," said he, "All right, keep your hair on. What a pity that dear Henry W. Longfellow cannot be induced to come and shake you by the hand. You are such a personification of his favorite line: 'Life is real, life is earnest.' You want to watch out my boy, you're slipping. Don't you know that the beginning of dignity is the end of youth?"

'Tis true I might have countered to the effect that a man may retain his youth without having recourse to the vernacular or indulging in persiflage when engaged in discussing events of some moment or question of importance, but a long and intimate acquaintance with Bill has convinced me that it would be wasted effort. Therefore, I said nothing and he proceeded.

"If it will make you feel any better, I shall adopt the method now so fashionable among our leading men of illustrating their talks with a chart or in some extreme cases with such a flock of charts that it no longer is a mystery why the Pullman rates were boosted 50 per cent.

"Taking the methods in the order of their relative familiarity we find the method shown in Fig. 1 used extensively for small sheaves ranging all the way from 3 inches to 24 inches in diameter. A split pattern is employed and the mold is rolled over twice during its construction. In this connection, it is interesting to note that several published descriptions of this method are likely to set the reader astray. The mistake in the description lies in the statement that the drag is the first part rammed. It should be apparent to the most superficial observer that if a mold is rolled over twice, the part first rammed inevitably will be on top when the performance is over. It also follows that if the drag is on the top and the cope containing the runner head is on the bottom the molder will experience some difficulty in pouring his iron.

"The correct method is to lay the complete pattern on a suitable follow board depressed in the center to bring the parting line of a 2-part flask on a line with the parting line in the pattern. Riddled sand is tucked in the groove of the pattern and ,in the case of large sheaves, long nails are bedded in the sand for reinforcement. After the groove has been tucked solid, the superfluous sand is removed and a slanting parting made all around from



SOME CHARTS ARE USED BY THOSE WHO GO DOWN TO THE SEA IN SHIPS WHILE OTHERS ARE PREPARED FOR THE BENEFIT OF THE SUCKERS WHO STAY ON THE LAND

the top edge of the pattern to the follow board. Parting compound is sprinkled over this and then the *cope* half of the flask is set on. A suitable gate pin is placed on the hub or between the arms, depending on the custom obtaining in the shop. The cope is rammed in the usual way, but instead of being lifted off as soon as it is rammed, a board is bedded on the back and it is rolled over. The follow board is removed and parting compound is sprinkled over the slanting parting which has been left by the board. In the event that no follow board is available or that the pattern happens to be an odd size, this parting will have to be made by hand. In either case after the parting compound has been dusted on, the *drag* half of the flask is set on, filled with sand and rammed. Now this is the point in which this method principally differs from all of the others. After the *drag* has been rammed it is lifted off and the bottom half of the pattern removed. The drag then is replaced, after which a bottom board is attached and the two halves of the mold rolled over as a unit. *Then* the cope is lifted off and the top half of the pattern removed, after which the center core is set and the mold closed and made ready for the iron in the usual manner.

"I have dwelt on this method at length because I never have seen it described propertly. In fact the only two descriptions I have read, as I have pointed out in the foregoing, are entirely misleading. The half pattern remaining in the mold while it is being rolled over the second time supports the delicate, hanging, green sand groove core, but at the same time the flask must be handled with skill and caution to prevent a drop out or a shift.

"The method shown in Fig. 2 is employed when a 3-part flask is available. While it may be used to make the ordinary grooved sheave it is more applicable to those types of castings comprising a straight vertical face confined between a top and bottom external flange. Crane and hoist drums furnish familiar examples. In those cases, the lower flange is made separately from the main body of the pattern. The lower half of the pattern either may be bedded in the drag or rolled over. After the parting is made, the cheek, or middle section of the flask is set on, the top half of the pattern adjusted and the remainder of the mold rammed up as usual. The cope is lifted off first, the main part of the pattern is drawn out of the cheek, after which the cheek is lifted and the bottom ring pattern removed. The mold is then reassembled.

"In Fig. 3 a method is illustrated which is employed principally for making sheaves of large diameter. An iron lifting ring provided with a back plate and suitable lifting holes serves to carry the sand in the groove of the wheel. In this method it is optional whether a drag is employed or not. Many of these large wheels are made in the floor, the only flask equipment required being the lifting ring and a cope.

"A variation of this type is used sometimes for making small sheaves. Suitable rings or wooden frames conforming closely to the outside diameter of the wheel are bedded in the drag surrounding the pattern and serve to carry the sand in the groove as already described.

"The method, show in Fig. 4 perhaps is the most familiar, at least in the machinery and jobbing foundries. The pattern is made solid and provided with an external circular core print. The mold is made in the same manner as any plain job in a 2-part flask and after the pattern has been withdrawn a dry sand ring core is set in the print to form the groove. In small wheels this ring core is all in one piece, but in large wheels it is made in sections of six or more parts depending on the diameter of the wheel."

"I have not the other chart by me just now," said Bill. "Showing the remaining six methods of making sheave wheels, but the next time I come over I shall bring it with me."

I assured him again that seven was my limit and if he could show me ten I should be pleased to have him do so. After he had departed I intimated to my sparring partner that I doubted whether Bill could show me ten methods of making a sheave wheel."

"Don't you worry," said she, "That fellow's head is full of wheels."

Blames Cancellations for Disturbed Business

Cancellation of contracts is one of the contributary causes for the present slump in business, according to a statement issued by the fabricated production department of the Chamber of Commerce of the United States. This conclusion was reached by the department after six months' study.

The influence of early repudiation of orders, it is pointed out, spread rapidly and brought about a creeping paralysis of industry. In a number of lines, partly because of cancellations, plants were reduced from overtime production schedule to three days a week and in some instances to a complete shut-down. Investigation of cancellations showed that there were cancellations mutually arranged which were beneficial to both parties, but there were many others which worked a hardship on either the buyer or seller. In an effort to restore confidence and avoid future misunderstanding these proposals are put forth by the department:

Draw contracts in conformity with the law of the state in which they are completed or accepted—making the obligations of both the seller and buyer equitable.

Provided in them for arbitration in case of dispute either under the State law, rules of trade organizations, or other adequate agency.

Incorporate questions in your credit inquiries, the answer to which will establish the applicants' cancellation record.

Consider it a duty and a privilege in protection to American business standards to report on inquiry those who unjustly and habitually disregard their contract obligations.

Establish an honor roll of those who have dealt with you for a term of years according to contract or terms—and let them know why.

Stand for "Golden Rule" policy throughout your business, taking losses if necessary to demonstrate you mean it.

Without preaching, keep before your employes and your trade continuously the value of good will built on kept promises.

Urge your trade or commercial organizations to record their disapproval of all practices which have led to the present unsatisfactory conditions. It will help strengthen the weak.

Manufactures Gaggers

The J. W. Paxson Co., Philadelphia, recently has added the manufacture of gaggers to its other activities. One of the many varieties of square steel rods used for concrete reinforcement is utilized for the purpose. They are made in five different sizes, ¼, 5/16, ⅜, ½, and 5/8 inch. The shanks range from 6 to 18 inches in length but the toes are cut to a uniform length of 4 inches. However, special shapes or odd sizes easily can be made to order. The company states that now it is offering its own product, deliveries can be based on a positive knowledge of conditions. Further, a stock of standard sizes always is kept on hand. For shipment they are packed in large heavy kegs which are of standard dimensions, easily handled and most likely to be delivered without breakage or loss.

Charles W. McKay has entered into partnership with P. C. Sherman with offices in the Monadock Block, Chicago. The new firm will be known as McKay and Sherman and will undertake the engineering valuation of industrial and public utility properties.

Industrial Relations Departments

According to the Author the Manufacturer of Any Product Will Find That It Pays to Promote the Family Spirit in the Industrial Life of All His Employes

BY JAMES W. BROWN

PRIMARILY the subject of industrial relations departments has nothing to do with production, but the influence of such a department should become manifest eventually in the way of a more harmonious relation among the men and a more loyal as well as a more productive organization. Without exception, every sane manufacturer will agree that there is a real opportunity and also a real need for a more earnest effort toward bringing greater harmony into the relations between manufacturing concerns and the people associated with them. The enormous development of these concerns adds much to the perplexity of the subject and multiplies the chances for misunderstanding between men and concerns.

The industrial relations department should be clearly placed as to its relative position in the organization. It should be separate and distinct from any production department or production superintendent, and should be free to approach the worker, the foreman and the superintendent without being responsible to, or having authority over either. The department should be a free lance, so to speak. It should act as an aid and counsel for each and an attorney for the defense wherever necessary. It should be considered as having a higher purpose than merely the direct money return, for we cannot expect to hold men's confidence unless we can command their respect, and only those whose example is uplifting and whose works are for the betterment of mankind, can hope to command the respect of their fellowmen.

Experience has convinced me that there is a money return from these efforts and that they pay a splendid return in the way of a more brotherly feeling among the people employed and a much more active interest in the success of the concern.

The oft-repeated biblical question, "Am I my brother's keeper?" may not be open to an unqualified affirmative answer, but we are evading our responsibility as members of a human family if we cannot most emphatically answer, "I *am* my brother's *brother*."

An industrial relations department calls for a peculiar combination of qualities in the guiding head. First and foremost we believe that the head of such a department should be a man of long shop experience, long enough to appreciate the viewpoints of the workman, his joys and his hopes, his plans and his ambitions. He should be intensely human in his thought of the needs of the people of his industrial family. He should be quick to meet men and listen to their side and be able to lead them to viewing all matters in a fairminded manner. Patience with foremen as well as workers is an absolute essential.

The effort of industrial relations departments should be an active influence toward proper environments, proper opportunities and proper compensation, and the avenues of effort leading to these ends are so varied and numerous that the writer prefers to be specific as to a few viewpoints rather than to generalize entirely.

Selecting the Right Men

Environments start with the employment office in selecting the right man for the task. That office should be supplied with the information as to just what sort of a man is required for each machine or job and these machines or jobs should be numbered and charted as to character of work. For instance, Job No. 45 is a plain air squeezer molding machine making small malleable chain belt links, 36 to 48 links in a mold and an equal number of cores to set. The molds are light, and there is not much iron to carry. The chart should contain this information, and should specify that the man for this job should be a light, active man whose experience had been on light work. Job No. 150 is a 20-inch engine lathe used to bore sprocket wheels on and using size cutters for both roughing and finishing. This job requires a young man with very little experience in running a lathe. The chart furnished the employment department should contain all of this information. The call would be made for "malleable molders" for Job No. 45 and for "machine men" for machine shop work in the case of Job No. 150. The interviewer in the employment department, by adroit and clever questioning should have no difficulty in learning which applicant is best fitted for each job he has to fill without the applicant knowing just what kind of a job is really open. Most men will elaborate upon their own qualities and fitness for any certain job if they are desirous of that particular job or are anxious to start with any particular concern. We feel that this is the scientific method to follow in selecting men.

After selection, men should be properly introduced in their department and here, the writer believes is a much neglected opportunity, for statistics show that the greatest percentage of turnover occurs in the first week of employment. A new entrant should be taken in hand by the foreman and introduced to his fellow workmen to make him understand that he has joined an industrial family and that he is accepted as a member of such. He should be shown the place his clothes are to be hung and the machine or bench he is to work on, as well as having the character of his work explained to him. He should then be introduced to the instructor who should make it plain to him that any information he may wish or any tools or supplies he may require or any help he might need, will be gladly furnished at any time. Besides all this, the instructor should make it his business to go to the new man frequently during the first few days to see that he has the things that will enable him to do his work efficiently as though he had been a member of the organization for a longer time. We know this pays real returns because we have tried this out in our own malleable foundry, after a long experience with the old barbarous method of putting a man in and letting him overcome the handicaps of the antagonism of a number of his fellow workmen who have been previously introduced in the same unscientific manner.

The matter of good living conditions in factories should be given sensible attention, for it is nonsensical to expect a man to be contented with his employment when toilet facilities are filthy and insufficient, when

From a paper presented at the convention of the American Foundrymen's held at Columbus, O., Oct. 4-8. The author, James W. Brown, is connected with Chain Belt Co., Milwaukee.

wash rooms are repulsive, when no clean provision is made for hanging street clothes, when ventilation and light are improper and heat in winter is insufficient.

The industrial relations department has much to do with the intellectual as well as the material man, and with his peace of mind and happiness. The valuable, dependable, efficient man is the happy contented man who enjoys his work, his associates and his concern.

Safety Measures Needed

One of the avenues of effort of the industrial relations department should be the furtherance of safety measures. We know of no one thing that more completely paralyzes men's confidence in their concern than to see their fellowmen handicapped in their earning capacity by the negligence of the concern in failing to protect men against conditions and practices.

The matter of clubs should receive much attention, for clubs furnish a splendid opportunity to develop the "industrial family" spirit in the organization. It is far better for the men of a concern to belong to a club whose aims and ideas are in harmony with the policies of their concern than that they should belong to an organization whose sole aim is to influence their relations with their employer through fear.

The company with which the writer is identified has a club for salesmen, superintendents, foremen and others which does much to unify the organization and develop the get-together spirit. We believe that if we can eat together and play together harmoniously, we surely can work together. A mutual relief association is being developed into a club for the rank and file of the organization so that men in greater numbers can get together and discuss subjects of mutual interest.

The girls of an organization should have their own club and be apart and separate from the other clubs. Their amusements often are along different lines than in the other clubs, and moreover, as a rule they do not care to listen to technical talks that are so interesting to men. The main reason for a separate girls' club is that the club gives an opportunity for working out problems of caring for, and the guidance of the girls who come into the industrial family which an association with the older and more sensible girls can give.

The men who have been with a concern for a long period of time deserve especial recognition because of the permanency of their service, and for such the company has its "Quarter Century" club. These men who were with the concern during the years that the business was being built up, had much to do with the making of a product that could be advertised and marketed and a reputation established out of which a future greater business could be developed. In recognition of their effort the club has been organized, and suitable badges certifying as to their membership given them. We are careful to explain to them that while we recognize the great service they have rendered in the past there is still a greater one they can perform in the influence they can give to the whole organization by their example of permanency and loyalty to our concern. Particular pains are taken to emphasize this point to them and to all employes. The badge given them to wear is a lettered gold shield. Members who have completed 15 years service are entitled to a red stone setting in the badge; those who have completed 20 years service a blue stone and those who have been with the concern 25 years have a diamond set in the badge. Both hourly and piece rate men who are members feel a great satisfaction in this graceful recognition of their long service with the company.

Another measure of encouragement in permanency of service is a birthday card which is sent to all employes who have been with the company two years or more. We send a tastefully gotten up printed greeting, but great care is taken to write a personal note in addition to the printing in order to get the thought to the whole family circle that we are personally interested in each and every one who is a member of our industrial family.

It is felt that the greatest recognition of permanency of employment lies in the vacation plan, which gives to all men who are not foremen but who have been with the firm the full term of three years ending Oct. 1 of any year a full week's vacation with the amount of pay they have averaged per week for the previous three months, regardless of whether they have been working piece work or day work. The management believes that a molder who has worked nine or ten hours a day year after year is entitled to a vacation as much as men who have been working less hours and under far more comfortable conditions. We can understand the irritation that a molder must feel to have to listen to a clerk or a timekeeper tell of the wonderful time he has had on his vacation, with pay. It is thought that this vacation plan pays the company in renewed effort and happier attitudes because the men come back telling of what a splendid time they have had and how their wives enjoyed the vacation with them. We hear such expressions as: "That was the first vacation I ever really enjoyed because I knew I was drawing my pay just the same," and "My wife says I must be working for a pretty good concern to be given a vacation with pay," etc. We make an effort to see the men before they go on their vacation in order to help them make it a real one, and to dissuade them from spending the week painting their homes or building new concrete steps or doing something that will rob both them and their families of the vacation they all so richly deserve.

One might go on writing on environments indefinitely but the thought ought to be that men are happier when they are given to understand that the personal touch between men and concerns is ever present and operative. An important office of the industrial relations department should be to search out the men in all the different departments who show ability and help prepare them for the next better job, so that they will be ready when that job presents itself. Good men are liable to be so hidden in a job, just because they do it well, that a foreman dislikes letting them go. Advancement in an organization serves to make more apparent the fact that opportunity is ready and waiting for any and all who will make the effort to fit themselves for better jobs, and discourages the thought, often expressed, that there is no chance to get ahead.

Schools Are Organized

As an aid to the development of employes, considerable attention is paid to schools and classes. An "office school" is planned to furnish instruction to the sales force and other office people. This is designed to enlighten them as to proper business methods and as to our own product. A speaker is brought in to talk on some business subject for the first part of the evening. This is followed by a short "get-together" recess, after which some one from our own organization gives a careful explanation of the construction, development and use of some one line of our product.

The classes for foremen are planned to bring to them the best knowledge available regarding the satisfactory handling of men and materials. In this school text-books and lesson sheets are furnished, somewhat similar to the correspondence school course, and in addition semimonthly lectures are given by a hired author-

ity on the subjects treated by the text books. These schools pay because they enable the company to develop into foremen the men who are trained and experienced in our own particular line of work.

For the men who are foreign born and feel the need of more schooling in the English language as well as in the other elementary lines, Americanization classes are provided. These classes among the workmen not only do much along educational lines but it is found that the men who attend these classes have a kindlier attitude toward the foremen and among themselves because of the attention they have received in the class rooms. We feel they pay well from that standpoint alone.

In some departments, notably the malleable iron foundry, portions of the shop are set apart for beginners' schools. The plan is to keep the molder apprentices separate from the journeyman molders and under the supervision and care of competent instructors who teach them the proper way of each operation and the reasons why. At stated intervals the apprentices are taken through different departments to follow up the castings they have made. We are convinced that this effort pays because we have graduated nearly 50 molders from our schools in the last nine months.

One phase of all the club and school effort that is not fully appreciated is the value of "association." All men profit by the interchange of thought and experience and shop workers are no exception. Association makes men more receptive to new thoughts and ideas.

Many concerns are slow to do the things that make men happier and more contented because the success of these efforts are difficult to figure in dollars and cents. We know that these things pay because we can compare our organization with others that do nothing along these lines and also with our own before we had done very much. The comparisons show wherein our efforts have resulted in a more unified organization which means a more successful organization and a happier industrial family.

In this, as in any other problem, we should keep definitely in mind the end we wish to accomplish. We are striving to establish a mutual confidence between employer and employe and to bring all to understand that the success of the concern means the success of all associated with it. We are convinced that the methods discussed in the foregoing paper are bringing about these results.

British Cupola Practice

An interesting test has recently been made on a cupola installed in the plant of the Midland Motor Cylinder Co., Smethwick, England, by the Constructional Engineering Co., Birmingham, England. The cupola is 25 feet 6 inches in height and 4 feet in outside diameter. The diameter inside of lining is 27 inches. The blast pressure during the blow under discussion was equivalent to 33 inches of water. The total weight of metal melted was 34,328 pounds equivalent to 17.16 net tons. The blast was on the cupola for 4 hours and 48 minutes. The melting rate was therefore 3.6 tons per hour.

During the melt there were 39 taps and the average weight of metal obtained at each tap was about 900 pounds. No special effort was made to drive the cupola at a rapid rate although good melting conditions were aimed at, the foundry in question specializing on high-grade automobile cylinders made to rigid specifications. The cupola was slagged out five times during the heat which commenced at 1:50 p. m. and ended at 6:40 p. m. The metal mixture was of a standard type for making motor-car cylinder and included a proportion of cold-blast iron.

General particulars regarding the foundry in which this cupola was installed by the Constructional Engineering Co., were published in the Dec. 1, 1920 issue of THE FOUNDRY.

Specializing in Electric Heating Problems

F. J. Ryan & Co., Franklin Trust building, Philadelphia, specialists in electric heating problems in both the metallurgical and the chemical industry announce the election of the following departmental executives: S. H. Ourbacker, director of engineering; F. A. Hall, director of sales; T. B. Bechtel, director of construction.

F. J. Ryan & Co. was organized by Mr. Ryan who has been allied with the electric furnace development since its commencement in this country. Mr. Ryan was formerly director and general manager of the Electric Furnace Construction Co. Later he became directing manager of the American Metallurgical Corp., the active business of which was terminated last October when F. J. Ryan & Co. was incorporated. The new organization will specialize exclusively in electro-metallurgy and electrochemistry. Departments for the manufacture of their own low-temperature ovens have been added, and structural and machine divisions created through associations with Philadelphia shops.

A New York office has been opened recently at 21 East 40th street under the direction of E. C. Melby. Mr. Melby will have supervision over the New York district and export field. His previous experience for a number of years in the export trade, specializing with the Scandinavian countries makes him especially adapted to this district.

Artificial Loam Mixtures

Question: Can you give me a yellow or brown loam mixture and a dry sand mixture for heavy brass and bronze work? What kind of material is used to black molds of that character? Any information you can give me on this question will be greatly appreciated.

Answer: The best material for either brass or iron is not a mixture. It is sand in the natural state just as it comes from the sand pit. If you have a considerable amount of loam or dry sand work on hand order a supply of brass sand either through one of the foundry supply houses or direct from the nearest sand company.

Where only an occasional dry sand or loam mold is required the ordinary molding sand can be doctored by the addition of sufficient sharp sand to open it up; but no mixture can equal the natural loam. Molding sand varies to a considerable extent in different parts of the country and without a knowledge of the kind you are using at present it would be impossible to submit the formula for a definite mixture. You probably will have to experiment a little to strike the right combination.

With the ordinary grade of sand usually employed in brass shops a 50-50 combination would be just about right. Add a shovel full of flour or any other dry core binder for every 20 shovels of sand and wet it down with water to the consistency of thick mud. Throw a handful of this mixture on a plate and dry it. If it is fairly strong and open after it has dried you can make up your mixture after this formula. If it appears to be too weak and crumbles to the touch it will be necessary to decrease the amount of sharp sand, or increase the quantity of core binder, or both. Sand suitable for loam molds also is suitable for dry sand molds.

Molds for heavy brass castings are blacked with the same materials and in the same manner as molds for heavy cast iron castings. In fact for some of the bronze mixtures, particularly phosphor bronze it is necessary to use the best grade of silver lead available. The blacking is mixed with molasses water or with a thin solution of any of the liquid core binders that are soluble in water.

Keep Foundry Equipment Repaired

In the Course of Time the Records Show That a Millwright's Wages Are More Than Covered by the Saving in Expense of Machine Repairs

BY DAVID McLAIN

ON THE invitation of the head of a manufacturing company whom we will call Mr. Smith because that is not anything like his name, I was visiting his plant on the theory that perhaps an outsider could place his finger on the sore spot more readily than any member of the organization. That there was trouble was evident from reports submitted by the executives of each department; but no one seemed to have the proper perspective to diagnose the cause. Mr. Smith voiced the feeling of many foundry owners at the present time when he asked me where we were going to secure capable foundry executives, men whose education included a pratical knowledge of metallurgy and the kindred arts of melting and molding and who also possessed an intimate working acquaintance with molding machines and other labor saving foundry equipment.

Sensing the opportunity of doing a little missionary work I asked him what his own company had been doing in that respect. He admitted that outside of a little talk at some of their meetings nothing had been done. At the last general meeting of heads of departments an effort had been made to straighten things out and fix the responsibility for unsatisfactory conditions; but apparently at the close of the meeting they were as far from a solution of the problem as ever.

Many Men of Many Minds

Williams, the manager believed everything was all right when every one was doing his bit, but was of the opinion that the labor shortage was responsible for the drop in production.

Jones, the machine shop superintendent severely criticized the loose methods employed in the foundry. He claimed that the output from the molding machines was only half their rated capacity, the castings were hard, and the surface of the castings was dirty notwithstanding the fact that they had an adequate sand blast equipment.

The chemist reported everything going along nicely in his department when the iron was poured hot and the different mixtures used properly; that is when soft iron was poured into molds designed to produce soft castings and hard iron poured into molds for hard castings. Occasionally these conditions were reversed and then there was more scrap to be remelted. He claimed that on account of the class of labor available it was extremely difficult to secure uniform melting conditions. However, a few days before he had been fortunate enough to engage a young man who understood English, to supervise the charging of the cupola and he anticipated better results in the future. He also claimed that the shortage of pig iron was seriously affecting the quality of their product. He had been obliged to cut down the amount of pig iron to 40 per cent and had to make up the remainder of the charge from scrap, sometimes not of the best quality.

The Machinist's Story

The foundry superintendent took exception to some of the statements made by the chemist. Mr. Smith, the manufacturer, said the meeting ended in a very unharmonious manner and suggested that I visit his plant and discuss the situation with the head of each department in order that we might devise some plan of action.

Smith appeared to think I should interview Mr. Jones, the machine shop superintendent, whom he said was a pretty broadgaged fellow and had studied the foundry operations from every angle. He was a stockholder and a director of the company, a forceful, energetic, practical machinist who had worked right up from the bottom.

"About 10 years ago we introduced the premium system in the machine shop and endeavored to put it in the foundry, but failed—not because the molders would not adopt it, but because the foreman and superintendent objected to it."

"Why did they object?"

"They claimed it was all very well to increase the speed of my machines, to use high-speed steel and to use portable cranes for medium and traveling cranes for heavy castings, but it required very little extra effort for the machinist to increase their output, while increased production in the foundry meant increased physical exertion for the molders."

"Why didn't you install labor saving equipment in the foundry?"

"We bought power squeezers, various types of molding machines, jar rams, air rammers, pouring devices, new blower, cupola, sand and cinder mills, sand cutter, sandblast, and we then believed we had solved our foundry problems.

"We obtained more perfect castings—more of them—cleaner than before, etc., but in a short time things began to go wrong."

"Before proceeding further, please enlighten me on a few points that are not quite clear. You invested quite a sum in foundry equipment but did you secure experienced operators?"

"I will admit we left that to the foundry executives."

"Are your foundry relations pleasant?"

"Yes."

"Let us visit the foundry."

The Foundryman Has His Say

The superintendent Mr. McArthur, and the foreman were very glad to discuss the foundry situation. "We were given a lot of new equipment and a demonstrator for a few days to teach the men how to operate each machine, but not a man in our employ had ever made a mold on a machine, nor understood rigging up for machines."

"I advised that we engage an instructor for the molding machine department—one who would teach the beginners and adjust or repair the machines when out of order. He should also be capable of laying out the patterns or match plates, and such a man would be worth his weight in gold, but as he demanded more salary than I was drawing, both Smith and Jones refused.

"Now a molding machine with patterns well fitted, is a producer and cost reducer but if anything goes wrong, they produce bad castings just as quickly.

"They expected me to fuss with

From a paper presented at a meeting of the American Foundrymen's association at the Columbus convention. The author David McLain is the founder of McLain's System, Milwaukee.

sandblast equipment and sand cutting machines, and Jones even refused to transfer one of his mechanics to the foundry payroll in order to keep the equipment in repair, so I handed in my resignation.

"Both Smith and Jones knew my heart was in my work, that I owned my own home and that I would have to leave town, so they refused to accept the resignation and gave me an increase in salary.

"They have not interfered but have given me no assistance, neither in experienced help or in obtaining apprentices for the foundry although they offer fancy inducements to machine shop apprentices. I wanted to indenture apprentices by paying them $10 per week and a bonus, and I would guarantee to make $30-a-week men of them the first year, but nothing doing, as Smith and Jones only got $2.50 per week as apprentices and could not find it in their hearts to pay more than they received.

Reduces Coke Ratio

"Now our chemist is a fine, clean-cut fellow but he did not spend six years in college to become a melter, nor will he devote much of his time to the foundry.

"He claims the cupola is in my charge but I maintain that the person responsible for the metal must exercise control over the melting department, and he lets the cupola go hang, which it does at times.

"For some months our iron has been on the dull side. He was using 425 pounds of coke (whether it was high or low carbon to 4200-pound charges of iron and it was necessary for me to call on Mr. Smith to change that to 525 pounds of coke to 5500-pound charges of iron. Since then we are getting hotter iron and 3 tons more per hour.

"Only a few days ago I went up on the cupola platform and the crew was just finishing a charge. Everybody was chattering; no one was thinking, so they began tossing in pig for the next charge instead of coke.

"The following day I discovered that our metal was low in silicon and manganese and I spent 30 minutes on the cupola platform while they threw in several charges of iron and coke but forgot to add the ferrosilicon and ferromanganese.

"A condition like that is demoralizing but fortunately the chemist happened along in this emergency and I believe realized for the first time the absolute necessity for co-operation.

"Although it is now six years since I began laboring with the equipment I maintain that it has cost this firm a fortune by not engaging instructors or inspectors.

"Here is an ash pit casting for a furnace. A molder and helper made 11 per 10-hour day before we installed that machine. Now a molder and three laborers make 45 castings per day with a record of less than 2 per cent loss. Just how much of my time was spent on that job before we got it going good. I don't know but it isn't wise to let those fellows run loose or things go wrong.

Loose Pins Cause Loss

"Only the other day 20 ash pit castings were lost in *one heat*, so I had to drop everything else and check up, or in other words, learn the cause of the trouble. I found the flask pins on the cope plate to be loose and as the drag had to be turned over, this threw the shift all on one side. The section of castings being only $\frac{3}{16}$ to $\frac{1}{4}$-inch thick, this shift left $\frac{1}{16}$-inch of metal in spots, which is entirely too thin.

"The molders had blamed the loss to dull iron, which was not allowed when I checked up and discovered that cause which could only have been averted if the men had understood how to prevent it, which I hope they do now.

"I claim that equipment should be inspected daily by a competent man. For instance, take a sand cutting machine. There never was a better investment made in this foundry, but look at the construction of it and then figure what it is up against in the way of mud, dirt, gaggers, etc. If you want to keep that going every night it must be inspected daily, oiled and kept in good shape.

"Sandblast equipment is as much machinery as the finest lathe, but I ask you to consider the character of the labor employed on each. A fine lathe is well taken care of but how about the sand blast? The machine shop superintendent is capable of repairing and testing the lathe because he knows the construction and operation of same, but how about the sandblast and other complicated equipment in the foundry? The nature of sandblast equipment makes it deteriorate rapidly if not kept up but are you going to depend on the foundry labor to keep it up?

"We have all kinds of trouble with our electric riddles and air hammers. Sand gets into the bearings—and by the way, if you will collect the air rammers every night and lay them in a bath of kerosene, blow out next morning and use a little good machine oil, you will secure better service.

At luncheon where we were joined by Mr. Smith and the manager Mr. Williams the foundry superintendent continued the discussion.

"I have studied the conditions in our foundry from every angle and maintain that we can never hope to attain 100 per cent efficiency by study-efficiency or business courses. We require 100 per cent common sense first of all, and should apply it to our problems.

"Take our cupola practice for instance. If the chemist is going to make the mixtures, let him master the science of melting first of all. If the metal is not hot, what's the use of speeding up the men? If the molding machines are not kept in repair, clean and oiled daily, and the flask equipment is deteriorating, there will be large casting losses.

"If the sand mixing, cutting and blasting machines, air and electric hoists, traveling cranes, blowers, and other similar machines are not kept in repair the foundry will not receive proper return for the money invested in this expensive equipment, and even though it would be of the most modern type it is not worth much if it is idle part of the time because proper attention is not given to repairs and maintenance."

Here the foundry superintendent was interrupted by Mr. Smith who said:

"Just a minute, this is a new angle to our problem. I don't think I have ever before considered the maintenance problem from the standpoint of return on investment. I think the foundry superintendent has stated the case thoroughly and although I have been opposed to spending too much money on mechanics in the foundry, I believe I am beginning to see that unless some thought and attention is given to the care of this equipment, it might just as well not be taking up space in the foundry."

Give the Plan a Trial

Turning to Mr. Williams he said: "Why don't we try this plan that the foundry superintendent has been trying to adopt all these years? I will admit that Jones, you and myself probably have been a little too cautious in our handling of the problem. We have opposed the foundry people simply because we haven't had the nerve to break away from tradition. Just because foundrymen in general all over the world have neglected their machinery and equipment ever

since they had anything that deserved the name of a machine, is no reason why we should keep on. Here we have thousands of dollars tied up in the molding machines, sand blast apparatus, air compressors, electric cranes and pneumatic tools and yet we are daily entrusting this expensive equipment to the mercies of some of the poorest men we have in the plant.

"Williams, you and I have been insisting on antiquated methods for the last five or six years; what do you say we give the foundry superintendent a fling at his own scheme?"

New Plan Proposed

Turning to the foundry superintendent, he said: "McArthur, this afternoon we will go to Jones and pick out one of the best all around mechanics he has in his shop. We will transfer this man to the foundry and explain to him that he is to have complete charge of keeping up the machine equipment in that department. He is to have immediate access to the facilities of the machine shop to help him keep the equipment in repair. Moreover, McArthur, you are to arrange some sort of a plan whereby all machine equipment in the foundry is inspected regularly. I believe that if we follow out a systematic plan of checking up this equipment and repairing it before it is too late, we shall increase the amount of work which we get out of our machines. Let's try this plan, say for six months and at the end of that time I believe that the results will be apparent to all of us."

The foregoing conversation took place something over a year ago in a well known foundry and machine shop. The plan outlined by Mr. Smith at this little luncheon was put in force that same afternoon. Mr. Smith and Mr. McArthur, the foundry superintendent, secured an old millwright from the machine shop who fitted in with the new job almost perfectly. He took pride in keeping the equipment in good shape and before long was boasting of the small amount of lost time caused by foundry machinery breaking down. The result soon was apparent in the smoother working of the various departments in the foundry and McArthur had the pleasure of seeing his suggestion carried out under favorable conditions.

Williams, who had taken only a lukewarm interest in the proposition at first, soon became enthusiastic over it, especially as his monthly report showed that the charges formerly appearing under the title, "Repairs to Foundry Machines," constantly decreased. In other words, the millwright was more than saving his wages by cutting down the cost of repairs. This was due no doubt to the fact that his systematic inspection of various machinery enabled him to correct small defects before extensive repairs were necessary.

The conditions outlined in the above story are typical of those prevailing in many plants in the United States. Many foundrymen have modern equipment but are not getting adequate return for their money simply because they are not utilizing this equipment advantageously. Foundry equipment must be cared for just as conscientiously as the machine tools in the machine shop and as soon as foundrymen break away from the traditional methods of the oldtime foundry and realize that a molding machine should receive as much attention as a drill press or engine lathe, their maintenance troubles will cease. The writer recommends that foundrymen who are having trouble in maintaining their machine equipment follow the example of Mr. Smith and for a trial period of at least six months, allow a reliable mechanic to take the responsibility of keeping the machinery in repair. If this plan is carried out intelligently no progressive foundryman will return to his old slipshod methods at the end of 6-months period.

Book Review

Chronology of Iron and Steel by Stephen L. Goodale; leather; 294 pages, 4 x 6¼ inches; published by the Pittsburgh Iron & Steel Foundries Co., Pittsburgh, and for sale by *The Iron Trade Review*, Cleveland; price $5 postpaid.

Important events in the development of iron and steel since pre-historic times have been compiled by Stephen L. Goodale, professor of metallurgy, University of Pittsburgh and edited by J. Ramsey Speer, chairman of the board of the Pittsburgh Iron & Steel Foundries Co. These developments are recorded in chronological order and are indexed in such a way that reference to any subject is readily available.

In a foreword the editor emphasizes the importance of iron and steel in every-day life and touches upon the the difficulty experienced in "sticking to the text," because "so many things outside of the industry have had such far reaching effect."

The chronology begins with the Biblical reference to Tubal-Cain as "the forger of every cutting instrument of brass and iron." Early developments in Egypt, Asia Minor, Assyria, Babylon, China, India, Austria, Greece, Italy, ancient Britain and ancient America are recorded. This is followed by historical data covering the period from 507 B. C. up to the present time. Beginning with the year 1776 the editor has designated the years 1776 to 1783 as the "revolutionary war period;" 1783 to 1856 as the "period of scientific development;" and 1856 to 1900 as the "steel age."

The book takes into account the scientific progress in iron and steelmaking in all parts of the world, the principal contributions to the knowledge of the industry being from English, French, Swedish, German and American investigators. The record from the early part of the nineteenth century up to 1920 deals with the rapid progress of the industry in the United States in entertaining detail, the important steps in the development of many metallurgical processes being traced in a painstaking manner.

A Correction

A statement appearing on page 153 of the Feb. 15 issue of THE FOUNDRY was in error. This item referred to the Standard Sand Co. as formerly the Standard Sand & Machine Co., Cleveland. The Standard Sand Co. mentioned is not and has not been a part or division of the Standard Sand & Machine Co. The latter firm disposed of its sand holdings some time ago, and the present Standard Sand Co. is a new organization which includes in its directorate some who are stockholders in the Standard Sand & Machine Co., makers of sand handling equipment.

Grate Bar Company Reorganizes

Reorganization of the Pyramid Grate Bar Co., Inc., New York, recently has been effected and the company is now known as the Pyramid Iron Products Corp. No change in personnel has been made. The company operates two foundries at Yonkers, N. Y. Officers are: President, O. S. Ironmonger; vice president, Frank Kingsland and secretary and treasurer, G. W. Elder Jr.

Alexander C. Barker has been made vice president and placed in charge of the Montreal, Canada office of Dwight P. Robinson & Co., Inc. This company is a consolidation of Westinghouse, Church, Kerr & Co., Inc., and Dwight P. Robinson & Co., Inc.

Analyze Loss in Aluminum Shops-VII

Rigidity of Specifications Covering Inspection Regulates Percentage of Rejections—Rules for Salvaging Liberty-Motor Castings Detailed—Records of Value in Preventing Loss When Properly Interpreted

BY ROBERT J. ANDERSON

SINCE casting losses are markedly affected by the rigidity of the specifications covering inspection, it is necessary to consider this item in some detail. Uniform inspection specifications for all kinds of aluminum-alloy castings do not exist, and it is obviously impossible to draw up such instructions. Various inspection instructions have been worked out by the larger foundries. Purchasers such as motor companies, have specifications covering the allowable defects permitted in castings for use in motor cars. In the final analysis, the vender and purchaser must decide to their mutual agreement what defects will be permitted in acceptable castings, and how serious a defect must be so as to cause rejection of the casting. Necessarily, the variations permissible are wide. Certain defects in one casting may cause rejection, but in another casting they would be inconsequential. One of the additional items affecting casting losses is that pertaining to salvage. If a defective casting can be salvaged by some repair method such as welding or soldering, then the casting will be acceptable and no loss will accrue other than the costs necessary to effect the salvage.

The comprehensive set of inspection and salvage specifications covering certain castings for the Liberty motor may be cited as a broad code of instructions. These specifications are more rigid than those usually enforced for automotive castings in general, but they serve to show the trend in the inspection and salvage of the highest class of aluminum-alloys and castings poured. Specifications as to the inspection of aluminum-alloy sand castings for the Liberty motor were fairly rigid, and considering the complexity of the crankcase, some foundrymen held that they were too severe. The greater part of the specifications are included in the following.

Salvage Instructions

Vendor Inspection—All castings shall receive a very close inspection by the inspection department of the foundry before being submitted to the government inspectors for approval. This inspection shall consist of inspection of the castings when removed from the molds as well as the final inspection after the castings have been completely trimmed and are ready for shipment. After this inspection is made by the foundry inspectors, the castings shall be submitted to the inspectors of the bureau for their approval. The vendor foundry will not be permitted to perform any repairing on castings before submitting them to the inspectors of the bureau.

Bureau of Aircraft Production Inspection—Metallurgical inspectors of the bureau of aircraft production will inspect only castings which have passed the vendor inspection. Castings which show small defects and which can be salvaged in accordance with the instructions given below will be salvaged under the direction of the inspectors of the bureau. No deviation from these instructions will be allowed without written permission from the proper authority. The chief inspector for the bureau at the plant of the vendor shall see that the material used is in accordance with the chemical and metallurgical specifications covering the castings and that the required number of physical tests are made.

Foundry Salvage—All castings which show metallurgical defects shall be salvaged in accordance with the instructions given in these specifications. All castings for which these instructions do not give proper disposition, and in the opinion of the inspectors of the bureau can be salvaged, shall be held for the attention of the chief inspector on castings who will make the proper disposition.

Welding—The welding of all rough castings shall be carried out as follows: The entire casting shall be preheated to a temperature of approximately 260 degrees Cent. (500 degrees Fahr.), or to a temperature at which the casting will not ring when tapped with a hammer. The defects to be welded must be thoroughly cleaned from any sand, oxide, or dirt, which would in any way interfere with the quality of the weld. The castings must be welded immediately after being removed from the preheating furnace. The welding stick used must be of approximately the same chemical composition as the casting itself. A finished weld must have the same contour as the original casting. The so-called *burning-in* of castings which show defects such as misruns or cracks, will not be al-

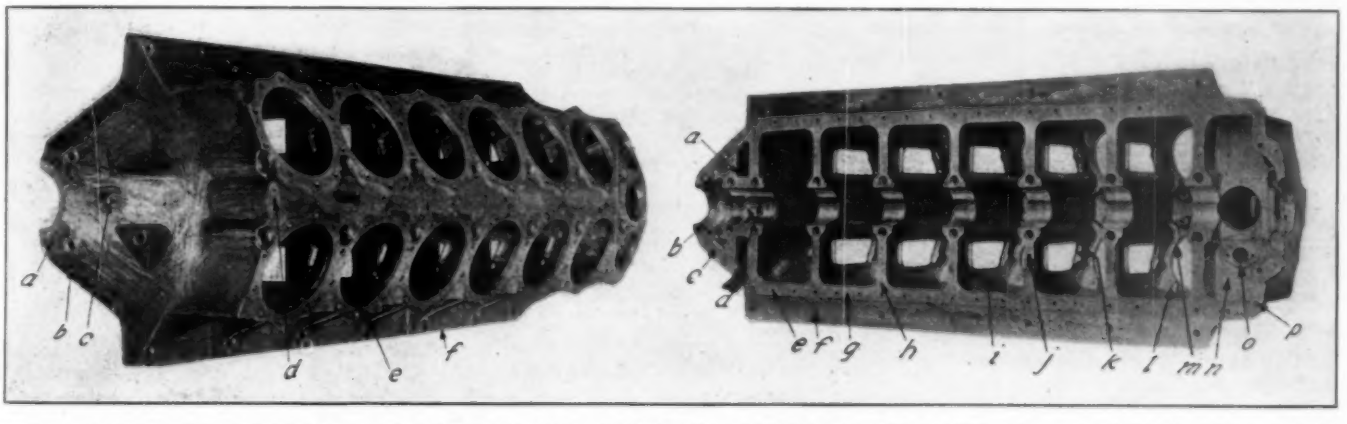


FIG. 3—TOP VIEW, LIBERTY 12-CYLINDER MOTOR CRANKCASE, PROPELLER END LEFT FIG. 4—BOTTOM VIEW, LIBERTY 12-CYLINDER MOTOR CRANKCASE, PROPELLER END LEFT

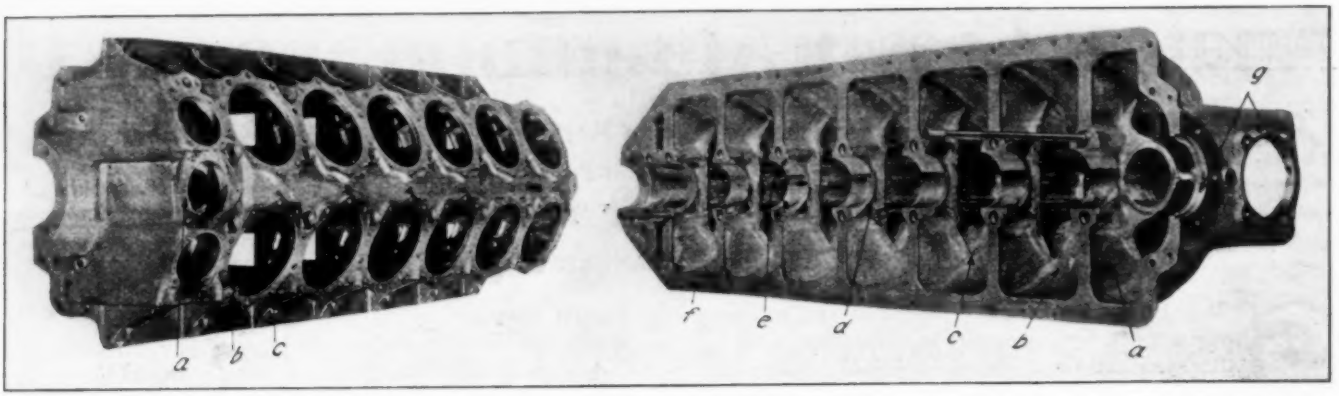


FIG. 5—TOP VIEW, LIBERTY 12-CYLINDER MOTOR CRACKCASE, PROPELLER END RIGHT FIG. 6—TOP VIEW, LIBERTY 12-CYLINDER MOTOR OIL PAN, PROPELLER END LEFT

lowed under any consideration. It will not be possible to weld any cracks on aluminum-alloy castings unless otherwise specified in detailed instructions listed here. No welding will be allowed on any ribs of upper and lower halves of crankcases. No welding will be allowed on propeller end of crankcase or oil pan beyond No. 7 rib.

Soldering—No soldering of any kind will be permitted under any consideration on aluminum-alloy castings to be used on the Liberty motor.

Seepage Leaks—Small seepage leaks which are detected by the open-gasoline test may be treated by any of the following methods:

(a) Bakelite under pressure.
(b) Bakelite and aluminum powder.
(c) Boiled linseed oil under pressure—castings must be baked after this treatment.
(d) Accelerated aging process.
(e) Annealing of castings at a temperature of not over 316 degrees Cent. (600 degrees Fahr.)

The use of aluminum powder and sulphur will not be permitted for the treatment of seepage leaks.

Blowholes—Small blowholes or gas pockets, which do not affect the strength of the casting and which do not leak when subjected to the open-gasoline test shall not be a cause for rejection, and castings containing such flaws shall be accepted as they are.

Appearance—No castings for use on the Liberty motor shall be treated or repaired in any way which will affect the appearance only.

Inspection and Salvage of Crankcases—Inspection and salvage instructions for the crankcase (upper half) for the Liberty 12-cylinder motor are as follows with reference to Figs. 3, 4 and 5. The letters on the illustrations refer to particular inspection points. Referring to Fig. 3:

(A) Acceptance or rejection stamp shall be placed on this boss.

(B) Cracks caused by rough handling which run into crankcase flange screw hole are acceptable provided crack does not extend beyond the hole.

(C) Castings showing porosity in this hole are acceptable provided casting does not show oil leaks after assembly.

(D) Castings which show hole at this point drilled off center must be referred to the production engineering department for disposition.

(E) Small cracks in ribs indicated, or small pieces broken from these ribs may be repaired by trimming rib with file until defect is completely removed and no sharp corners remain. Defects of this nature shall not penetrate any rib more than 0.375 inch.

(F) Small cracks on this flange due to rough handling are acceptable if 0.125-inch hole is drilled at end of crack. No welding of cracks of this nature is acceptable.

As applied to Fig. 4:

(A) Great care shall be taken to see that no castings are accepted showing shrinkage cracks under thrust bearing retainer and propeller-hub bearing seat.

(B) Castings which show bearing felt retainer inner wall not less than 0.0625-inch thick are acceptable. Castings showing corners undercut, so that thickness of wall between corners and bolt holes at this point is not less than 0.625-inch thick, are acceptable.

(C) Castings which show holes drilled too near edge of flange are acceptable, providing no oil leaks occur after assembly.

(D) Castings showing leaks in No. 7 bearing by the open-gasoline test, indicate presence of blowholes under the bearing, and they shall be rejected.

(E) Cracks, which penetrate the flange at this point and stop, are acceptable as they are. No welding of this type of defect is permissible.

(F) Cracks, which penetrate the flange at this point and stop, are acceptable as they are, unless the crack does not run into a hole, then a 0.125-inch hole should be drilled at the end of the crack. No welding is permissible on this type of defect.

(G) Cracks which penetrate to a point not beyond the center line of holes are acceptable when a 0.125-inch hole is drilled at the end of the crack. No welding of defects of this kind is permissible.

(H) Castings showing porosity on surface are acceptable providing they do not show oil leaks after assembly, or after having completed acceptance run. No shellac or other foreign material shall be used for stopping these leaks.

(I) Castings showing holes or misruns in webs indicated shall be rejected.

(J) Cracks in ribs indicated are not acceptable.

(K) Cracks at points indicated are not acceptable.

(L) Cracks in bosses are acceptable, provided they are not over 0.375-inch long. In case two cracks occur in the same boss and are not more than 0.125-inch apart, section between cracks shall be removed. A maximum of two cracks will be allowed to a single boss, and there shall not be more than one defective boss to a cylinder.

(M) Depressions in surface due to core fins which are not over 0.0625-inch deep are acceptable. In every case, such depressions must be thoroughly cleaned.

(N) Sand holes in this face are acceptable, provided that they do not leak on the open-gasoline test. In case small sand holes are found that leak, these

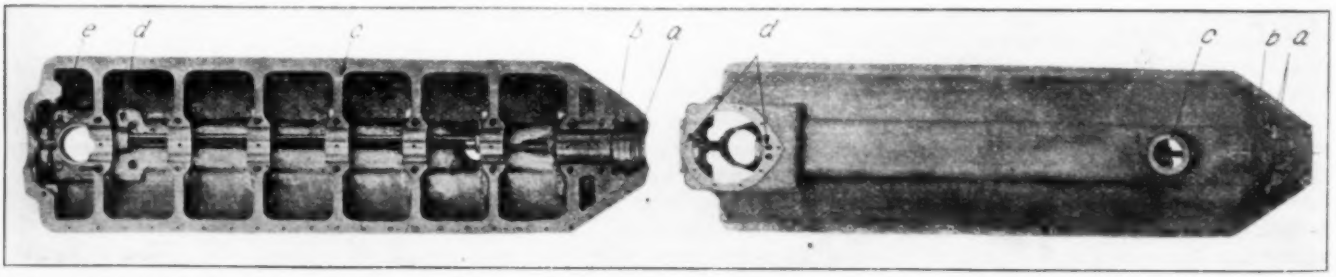


FIG. 7—TOP VIEW, LIBERTY 12-CYLINDER MOTOR OIL PAN, PROPELLER END RIGHT FIG. 8—BOTTOM VIEW, LIBERTY 12-CYLINDER MOTOR OIL PAN, PROPELLER END RIGHT

THE FOUNDRY DATA SHEET, MARCH 15, 1921

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

USES OF NONFERROUS ETCHING SOLUTIONS

By Ernest J. Davis

REAGENT	ALLOY MOST SUITED FOR	STRENGTH	TIME OF ETCHING	WASH	METHOD OF USE
Hydrochloric acid	White bearing alloys high in tin	20 per cent in water	According to development of structure	Wash well with water	Immersion
Nitric acid	Phosphor-coppers; copper-silver alloys	Density 12	About 5 sec. according to alloy	Wash with water	Immersion
Nitric acid	Brass	50 per cent in water	Dip in and out	Wash well with water	Immersion
Nitric acid	White bearing alloys generally	1 per cent in alcohol	According to development of structure	Wash with alcohol	Immersion
Aqua Regia	Alloys of gold and platinum	Concentrated	A few seconds just below boiling	Wash well with water	Immersion
Aqua Regia	Gold alloys	1 HNO_3, 5 HCl and 6 of H_2O	According to development of structure	Wash well with water	Immersion
Chromic Acid	Alloys rich in lead	Strength according to composition of alloy	5-10 seconds	Wash with water	Immersion
Ammonia	Alloys of copper and zinc	1:3 in water		Wash with water	Rub on gently with finger
Ammonia and Hydrogen peroxide	Alloys of copper and zinc	1:3 NH_4OH in water and a few drops of hydrogen peroxide	According to development of structure	Wash well with water	Immersion
Ammonium persulphate	Alloys of copper and zinc also copper and tin	10 per cent in water	5-10 seconds	Wash in water	Immersion
Ammonia and Ammonium persulphate	Alloys of copper and zinc	A few drops of a 10 per cent solution of ammonium persulphate in 1:2 ammonia	According to development of structure	Wash in water	Immersion
Ammonia and Ammonium persulphate	Alloys of copper and zinc, manganese bronze, etc.	1:3 ammonia to which is added a large excess of persulphate	5-10 minutes or longer as required	Wash in water	Immersion or painting on

(Concluded on Data Sheet No. 374)

USES NONFERROUS ETCHING SOLUTIONS

By Ernest J. Davis

Concluded from Data Sheet No. 373

REAGENT	ALLOY MOST SUITED FOR	STRENGTH	TIME OF ETCHING	WASH	METHOD OF USE
Acid ferris chloride	Alloys of copper-zinc phosphor bronzes, manganese bronze, etc.	Ferric chloride 10 grams, hydrochloric acid 30 cc water 100 cc	5-10 seconds	Wash in water	Immersion
Caustic soda	Aluminum alloys rich in zinc	20 per cent in water	According to development of structure	Wash well in water	Immersion
Caustic soda	Aluminum nickel alloys	10 per cent in water	According to development of structure	Wash well in water	Immersion
Caustic soda	Aluminum	Saturated solution in alcohol and a few drops of water	30 minutes or more	Wash well in alcohol	Immersion
Caustic potash	Aluminum alloys	20 per cent in water	According to development of structure	Wash in water	Immersion
Hydrofluoric acid	Aluminum copper	10 per cent in water	According to development of structure	Wash in water	Immersion
Hydrofluoric acid	Copper	20 per cent in water	According to development of structure	Wash in water	Immersion
Nitric acid	Aluminum-magnesium alloys	10 per cent in alcohol	According to development of structure	Alcohol	Immersion
Copper Ammonium chloride	Copper alloys rich in copper	Excess of ammonia is added to a solution of 5 grams copper chloride in 100 cc H_2O	5-10 seconds	Wash in water	Immersion
Bromine water	Alloys rich in copper		According to development of structure	Wash in water	Immersion
Iodine	Alloys rich in zinc or cadmium	1 part to 3 parts KI and 10 parts H_2O	According to development of structure	Wash with water	Immersion
Silver nitrate	Alloys of lead, tin or bismuth	5 per cent in water	According to development of structure	Wash in water	Immersion
Heat tinting	Copper and copper alloys		Depending on color	Wash in water	Immersion

ELECTROLYTIC ETCHING:

It is sometimes convenient to assist the etching process by an electric current, the specimen being made the anode in a solution for an electrolytic, which may be ammonium nitrate or any other neutral salt.

Le Chatelier obtained good results with copper-tin alloys by using sodium thiosulphate.

Ammonia may be used with copper alloys generally.

The specimen is made the anode and a piece of platinum foil is made, the cathode and a current of 0.01 amp. or less is usually sufficient. The specimen is examined from time to time during the process.

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

holes may be repaired by the use of a 0.125-inch aluminum pipe plug. The plug must have at least three effective threads, and it must be screwed in tightly and cut off flush with each side of the casting. No peaning will be allowed. After being repaired the casting shall undergo an open-gasoline test for leaks.

(O) Sand holes on this face are acceptable, provided they are thoroughly cleaned and do not show oil leaks.

(P) Cracks which penetrate to this depth are acceptable, provided they run into bolt hole. Cracks which do not run into bolt hole or do not extend beyond the center line of the hole are acceptable after a 0.125-inch hole is drilled through the flange at the end of the crack.

The following apply to Fig. 5:

(A) Castings showing porosity on this face are acceptable, provided no oil leaks occur after assembly.

(B) Castings showing porosity on the surface indicated are acceptable, provided no oil leaks occur after assembly.

(C) Castings showing small cracks at this point due to use of oversized stud are acceptable, provided they are less than 0.375-inch long and not more than one crack occurs on each cylinder pad.

Inspection and Salvage of Oil Pans—Inspection and salvage instructions for the oil pan (lower half) for the Liberty 12-cylinder motor are as follows, with reference to Figs. 6, 7 and 8. As before, the letters on the illustrations refer to particular inspection points.

Referring to Fig. 6:

(A) Holes in ribs which, after being thoroughly cleaned, are not over 0.375-inch diameter or equivalent area, and which are located at least 0.50-inch from fillet, are acceptable.

(B) Holes which are located at least 1 inch from ribs are acceptable when such holes can be repaired with a 0.125-inch aluminum pipe plug. The plug must have at least three effective threads, and it shall be screwed in tightly and cut off flush with each side of the casting. No peaning will be permissible. After being repaired, the castings shall undergo an open-gasoline test for leaks.

(C) No shrinkage cracks at this point are permissible. Small cracks, due to the chipping chisel striking the wall on chipping, which occur on the outside of the casting at this point, are acceptable as they are, provided the casting will stand the open-gasoline test for leaks. No peaning of cracks is permissible.

(D) Castings which show not more than two small cracks on any single boss, due to tightening of the bearing bolt, are acceptable. Castings which show cracks at this point, in the rough conditions, are defective and they must be scrapped.

(E) Castings, on which corners of bearings show sand holes or small nicks, are acceptable, provided these are cleaned properly and do not extend more than 0.375-inch from the edge of the bearing and not more than 0.375-inch along the side of the bearing. Castings showing porous bearings are acceptable, provided the sand holes are not more than 0.125-inch diameter. The holes shall not make up more than 10 per cent of the surface area of the bearing, and they shall not be more than 0.125-inch deep. In case only one sand hole is found on a single bearing, and the diameter of the hole is not more than 0.25-inch, the casting shall be accepted.

(F) Small cracks in the flange caused by rough handling are acceptable, provided the crack is at least 0.375-inch from the base of the radius and does not run beyond the center line of the bolt holes, if a 0.125-inch hole is drilled at the end of the crack. Cracks which extend beyond this point cannot be repaired on finished castings. However, if cracks are present on rough or semi-finished castings and do not extend beyond this point or down the side of the casting to a depth not to exceed the width of the flange, such cracks may be repaired by drilling a 0.125-inch hole at the end of the crack and then welding.

(G) Castings which show porosity or sand holes on the surface indicated are acceptable, if thoroughly cleaned to a bright surface provided no leaks will occur at these points after assembly.

Then referring to Fig. 7:

(A) Castings which show bearing-felt retainer inner wall not less than 0.0625-inch thick are acceptable. Castings showing corners undercut so that the thickness of the wall between the corners and the bolt holes at this point is not less than 0.0625-inch thick are acceptable.

B) Castings showing shrinkage cracks under thrust-bearing retainer shall be scrapped. Extreme care shall be taken to see that no shrinkage cracks occur at this point.

(C) Castings showing general porosity over finished surface are acceptable, provided no oil leaks occur after assembly, or after completing acceptance test. No shellac or other foreign material shall be used to stop such possible leaks.

(D) Sand holes, misruns, and small cold shuts are acceptable at this point, provided such defects are not more than 0.50-inch diameter..

(E) Small cracks which occur on bosses at this point are acceptable provided not more than two cracks occur on a single boss.

The following apply to Fig. 8:

(A) Porosity and sand holes in bolt holes, or spot-faced surfaces, are acceptable when thoroughly cleaned, provided the casting does not leak at this point and that the depth and extent of the defect is apparent.

(B) Defects which occur at this point shall not be repaired by welding.

(C) Castings which show porosity on this machined surface are acceptable, provided no leaks occur after assembly.

(D) Rough castings which are light of stock on this flange shall be repaired by welding stock on the flange. Castings which show porosity on the finished surface are acceptable, provided no leaks occur after assembly.

(E) Minimum wall thickness of cast-

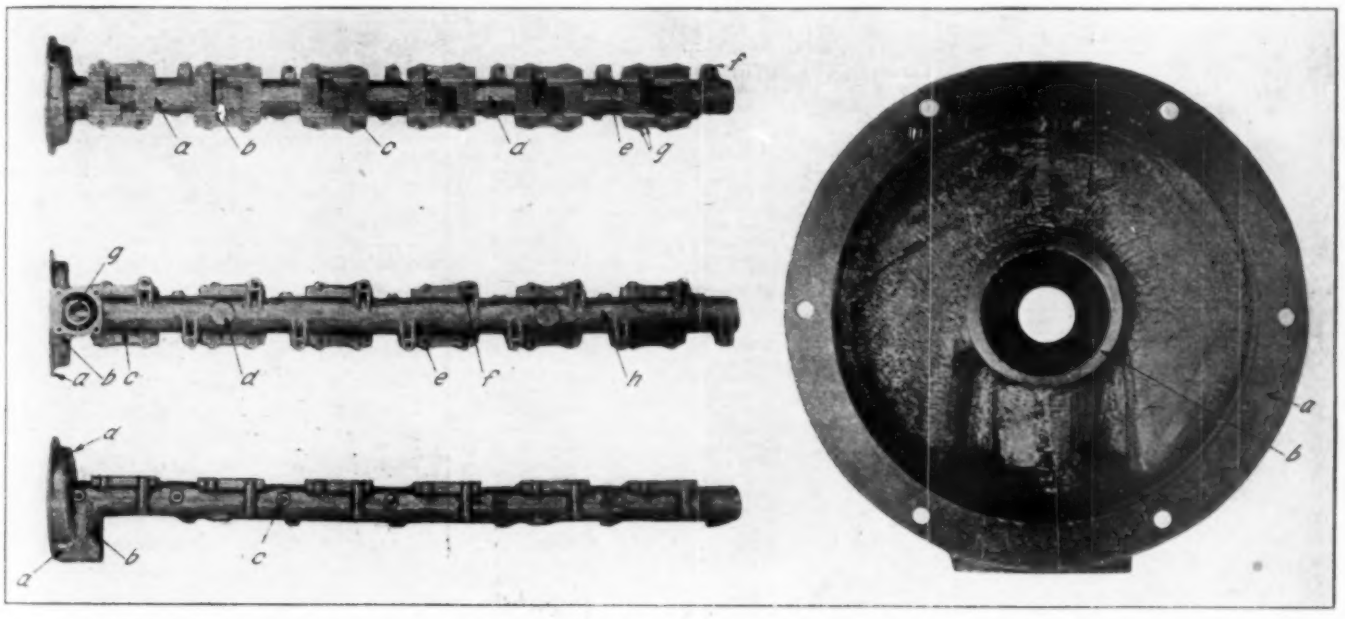


FIG. 9—BOTTOM VIEW, LIBERTY 12-CYLINDER MOTOR CAMSHAFT HOUSING FIG. 10—TOP VIEW LIBERTY 12-CYLINDER MOTOR CAMSHAFT HOUSING FIG. 11—SIDE VIEW, LIBERTY 12-CYLINDER MOTOR CAMSHAFT HOUSING FIG. 12—END VIEW, LIBERTY 12-CYLINDER MOTOR CAMSHAFT HOUSING

ings, variable because of core shifts, shall be 0.125-inch.

Inspection and Salvage of Camshaft Housings—Inspection and salvage instructions for camshaft housings for the Liberty 12-cylinder motor are as follows with reference to Figs. 9, 10, 11 and 12. The letters on the illustrations refer to particular points of inspection.

The following refers to Fig. 9:

(A) Shrinkage cracks at or adjacent to fillet at this point are acceptable, provided such cracks can be completely filed out or scraped out, and provided, further, the remaining section is not diminished more than 0.03125-inch. A series of sand holes in this part of the casting is cause for rejection.

(B) All porous spots on this surface must have all foreign matter removed. Castings with porosity making up more than 10 per cent of the bearing surface shall be rejected.. Porous spots shall not be more than 0.125-inch wide.

(C) Castings showing porous finished surface are acceptable, provided the porosity is not sufficient to cause leaks after assembly.

(D) Small shrinkage cracks or stress cracks are acceptable at this point, provided they can be removed by filing or scraping, and the section is not diminished thereby more than 0.01575-inch.

(E) No cracks of any kind are acceptable at this point.

(F) All castings which are salvaged shall be properly marked with either an acceptance or rejection stamp at this point.

(G) Castings are acceptable in which the small flange at this point is not completely filled out, provided the castings will show no leaks after assembly.

Considering Fig. 10:

(A) Castings which show thin flange at this point are acceptable, if the flange is not less than 0.1875-inch thick.

(B) Castings which show porosity on this face are acceptable, provided no leaks occur after assembly.

(C) Small shrinkage cracks at this point are acceptable, if such cracks can be completely removed by scraping or filing and the section is thereby diminished not more than 0.01575-inch.

(D) This point must not be peaned, and it must not leak when subjected to the open-gasoline test.

(E) Great care must be taken to avoid cutting main body with trimming chisel.

(F) Small depressions on core fins at this point are acceptable, provided the depression is not more than 0.03125-inch.

(G) Castings showing thin wall at this point are acceptable, providing the wall at the thinnest portion is at least 0.09375-inch thick.

(H) Small cracks due to straightening are acceptable if such cracks can be completely removed by filing or scraping without reducing the thickness of the wall at this point more than 0.03125-inch. Sand holes occurring on the body of the housing must not be more than 0.04725-inch deep.

Referring to Fig. 11:

(A) Small shrinkage cracks at this point on rough castings may be welded after being thoroughly cleaned.

(B) Castings which show small leaks due to sand holes at this point may be plugged with a 0.125-inch aluminum pipe plug. The plug must have at least three effective threads, and it shall be screwed in tightly and then cut off flush with each side of the casting. No peaning will be allowed. After being repaired, the casting shall undergo an open-gasoline test for leaks.

(C) Holes which are eccentric at this point are acceptable, provided the thickness of the wall at the thinnest portion is not less than 0.0625-inch.

(D) Small cracks due to trimming inside of bell are acceptable, provided the cracks do not leak on the open-gasoline test.

According to Fig. 12:

(A) Castings showing porosity on this surface are acceptable, provided no oil leaks occur after assembly.

(B) Castings showing thin wall are acceptable, provided the thinnest portion is not less than 0.0625-inch thick.

Specifications for the inspection and salvage of pistons for the Liberty motor are also included in the instructions of the bureau of aircraft production, but since these are usually diecast or cast in a permanent mold they are not included here.

Table XXI

Monetary Losses Calculated for a Production of 81,000,000 Pounds

On the basis of casting loss, per cent	On the basis of different costs per pound of scrapped castings, cents	Casting loss may be regarded as	Cost may be regarded as	Monetary values
5.0	7.5	low	low	$ 319,736.85
7.5	7.5	fairly low	low	492,567.60
10.0*	7.5	average	low	675,000.00
12.5	7.5	fairly high	low	867,857.18
15.0	7.5	high	low	1,072,058.85
20.0	7.5	very high	low	1,518,750.00
5.0	10.0	low	fairly low	426,315.80
7.5	10.0	fairly low	fairly low	656,756.80
10.0	10.0	average	fairly low	900,000.00
12.5	10.0	fairly high	fairly low	1,157,142.90
15.0	10.0	high	fairly low	1,429,411.80
20.0	10.0	very high	fairly low	2,025,000.00
5.0	12.5†	low	average	532,894.75
7.5	12.5	fairly low	average	820,946.00
10.0	12.5	average	average	1,125,000.00
12.5	12.5	fairly high	average	1,446,428.63
15.0	12.5	high	average	1,786,764.75
20.0	12.5	very high	average	2,531,250.00
5.0	15.0	low	fairly high	639,473.70
7.5	15.0	fairly low	fairly high	985,135.20
10.0	15.0	average	fairly high	1,350,000.00
12.5	15.0	fairly high	fairly high	1,735,714.35
15.0	15.0	high	fairly high	2,144,117.70
20.0	15.0	very high	fairly high	3,037,500.00
5.0	20.0	low	high	852,631.60
7.5	20.0	fairly low	high	1,313,513.60
10.0	20.0	average	high	1,800,000.00
12.5	20.0	fairly high	high	2,314,285.80
15.0	20.0	high	high	2,858,823.60
20.0	20.0	very high	high	4,050,000.00
5.0	25.0	low	very high	1,065,789.50
7.5	25.0	fairly low	very high	1,641,892.00
10.0	25.0	average	very high	2,250,000.00
12.5	25.0	fairly high	very high	2,892,857.25
15.0	25.0	high	very high	3,573,529.50
20.0	25.0	very high	very high	5,062,500.00

*The average casting loss for the country is placed at about 10 per cent for all kinds of castings.
†The average cost of scrapping a pound of casting is placed at 12.5 cents for all kinds of castings.

Interpretation of Casting-Loss Data

The problem of reducing casting losses in aluminum-foundry practice is one which must be worked out in individual foundries and steps for the purpose of lessening these losses should be taken by the foundrymen themselves. Sufficient has been said to demonstrate the fact that the subject of metal wastes and scrap losses is important in a high degree to the economic interest of the country. In foundry work, the scrap factor should be considered in cost estimates, and it is courting trouble to quote work at uniform pound prices without regard for the specific quantities and kinds of the castings. The value of adequate casting records becomes apparent when an analysis of such records is made, because it is only by determining the main causes for losses that corrective measures can be applied.*

Reliability of Records—In the final analysis, the reliability of the casting records can never be any better than the reliability of the inspectors who compile them. The selection of the correct type of men for the position of inspector will go a long way in insuring reliability of casting records. Unfortunately, too often but little attention is paid to this matter, but a competent inspector will be able to save more than twice his salary in a short time provided his services are utilized to the fullest advantage. The experience of the larger aluminum foundries, which maintain ade-

*Scott, W. G., Production cost and profit control in nonferrous foundries, *The Metal Industry*, vol. 17, 1919, pp. 417-420.
Church, A. H., Manufacturing costs and accounts, McGraw-Hill Book Co., Inc., New York, 1917, pp. 87-91.

quate inspection departments, has been that a man trained as a machinist, and preferably one who has had some experience as a molder in addition, is the most desirable type for an inspector. Such a man usually has sufficient technical ability to serve satisfactorily as an inspector and at the same time enough general education to make out reports in the desired form. The reliability of the records can never be high unless the proper type of man is selected to make them out. Usually, it will be best to have the inspector make out the records during the time when the castings are inspected. Some executive ability and considerable tact are necessary qualifications of the successful inspector, for he may be called upon often to settle minor disputes in the shop.

Value of Records in Preventing Losses—The casting-loss data furnished by the production reports should give a complete record of the causes for every individual rejection. In the foundry itself, the greatest use may be made of such records in determining the causes for losses. By so doing steps may be taken to prevent the continued occurrence of the same defects in the castings in future production, and casting losses and production costs can thereby be reduced. In the present investigation it has been found that not over 10 concerns keep detailed records. In the majority of the foundries no records at all were kept; in others the average casting losses were known but the records were not kept with a view to segregating the causes for losses; in others the detail was insufficient. In a few foundries casting-loss data are kept in great detail and the records are utilized to the greatest advantage, both in accounting and for the purpose of analyzing the causes for defects. Several foundries use their records largely for the purpose of computing wages under piece-rate systems of wage-payment, but a properly kept record will provide the requisite data for the accounting department, the timekeeper and the trouble man.

Interpretation of Casting-Loss Records—The interpretation of casting-loss data in the foundry must be made with due regard to the many determinate factors which affect the losses, particularly the kind and design of casting and the method of molding. Properly kept and interpreted, casting records prove to be of great value in correcting defects in castings, and thus enable the foundryman to reduce losses.

Use of Records in Accounting—Costing in a jobbing shop is one of the most difficult phases of accounting with which the cost accountant has to deal, and inaccurate records will never permit fair costs to be determined. Without going into a discussion of cost accounting, even briefly, it is evident, of course, that it is highly inaccurate to distribute the casting loss in a foundry at so much per pound over all kinds of castings, where the loss in the production of one type of casting may consistently average about 1 per cent and of another as high as 15 per cent. Neither job will thus bear its true burden of the cost and the production costs of either casting cannot be known. Where the loss is distributed as a lumped average, some castings apparently may seem to cost more than they should, but such inaccurate costs are due largely to the method of distributing the losses. Under the present conditions of close competition, scrap-loss costs should be prorated to the individual kinds of castings. Otherwise, work may be quoted too high and not secured, or quoted too low and cause financial losses.

It has already been made clear that the prevention and reduction of casting losses is highly desirable from the standpoint of the individual foundry because of the effect of high losses on profits. From the national standpoint it is also essential that losses be reduced to a minimum because the total monetary losses of the country mount to high figures. For the purpose of calculating, the melting losses, fuel losses and machine-shop returns will be disregarded, and figures for the probable monetary losses in the United States in 1919 because of scrappage of aluminum-alloy sand castings will be given on the basis of an output of 81,000,000 pounds of finished castings and various loss percentages. Taking an average casting loss of 10 per cent for all kinds of castings and an average cost of $0.125 per pound of scrapped castings, the average monetary loss of the country for 1919 may be calculated according to the following:

81,000,000 pounds = total output,
10 per cent = average casting loss
$0.125 per pound = cost of scrap.
81,000,000 = 90 per cent of the actual castings poured, or

$$\frac{81{,}000{,}000}{90} \times 100 = 90{,}000{,}000 \text{ pounds of actual castings poured}$$

so as to obtain 81,000,000 pounds of accepted castings. On the basis of a 10 per cent casting loss, the figures are:
90,000,000 x .10 = 9,000,000 pounds of castings
90,000,000 x .10 = 9,000,000 pounds of castings scrapped
9,000,000 x $0.125 = $1,125,000, the total monetary loss.

If the figures of 0.80 per cent for machine shop returns because of defective castings be included, then the total monetary loss may be placed at approximately $1,200,000. On the basis of various assumptions for casting losses and costs of scrapping castings, Table XXI has been constructed which is self-explanatory. If the present average losses in casting could be reduced 50 per cent, which is possible by eliminating the occurrence of readily avoidable defects, a saving of at least $600,000 would accrue to the country.

How and Why in Brass Founding

By Charles Vickers

Using Aluminum Additions in Yellow Brass

We have lately experienced considerable difficulty in making yellow brass castings in the form of flat collars about ⅜-inch thick. We use an alloy consisting of copper, 65 per cent; zinc, 28 per cent; lead, 2 per cent. In order to make the metal run nicely, the foundry foreman claims he has to use as a flux, a small piece of aluminum, but some of the customers object to the color produced claiming the castings look too white, also that they contain hard spots which causes the metal to break loose when being buffed. A suggestion has been made that we use phosphorus in place of the aluminum to produce a better running alloy. We have tried this find that it produces so much smoke it is difficult to see to pour the castings. We would like to learn what flux is usually added to yellow brass, and if it is possible to use phosphorus.

Aluminum is the best metallic flux for yellow brass as it suppresses zinc smoke by reason of the tenacious film it gives to the fluid metal. It also adds greatly to the fluidity of the alloy, and thus makes it much more easy to get perfect castings. It has one great drawback, and that is it causes excessive drossing, and it is this dross that is responsible for the *hard spots* complained of. To avoid this drossing, gate so the brass runs into the mold smoothly. There must be no agitation, otherwise dross will form. Phosphorus is

not suitable for use in connection with yellow brass and it is not used. With yellow brass of high zinc content it is necessary to use aluminum and the foundry foreman is quite correct in this practice. If the customer objects to the color of the castings, probably he will not object to a more expensive alloy. Without the aluminum, less zinc must be added, the following alloy being suitable: Copper, 68 per cent; zinc, 27 per cent; tin, 2 per cent; lead, 3 per cent. It can be run without using aluminum.

Die Casting Lead Sheets

We are die casting lead sheets, 18 inches square and 1-16-inch thick. The sheets have a tubular opening in the center, 3 inches in diameter and 3 inches high, also 1-16-inch thick. We find when the dies are thought to be properly heated and the mold is poured under a slight pressure that in a great many instances the castings are cold shot and fail to fill the mold properly. Is there any practical way in which a partial vacuum could be applied to the mold to ensure the metal running a complete casting?

The first essential to the production of die castings is a good die-casting machine. Such a machine, not only furnishes means for the proper operation of the die, but puts air pressure on the metal and also exhausts the die. It would be advisable to investigate the possibilities of a regular die-casting machine in making these castings. Other suggestions are, to vent the mold by cutting little channels for the escape of the air from the mold cavity. These channels extend from the cavity to the outside of the die. Another way of making these forms would be to use sheet lead and to attach the separately formed tubular part by soldering. Another suggestion is that the shape be pressed from sheet lead.

Hot Mill Bearings

What is the difference between a hot mill bearing and a regular bearing? We have seen bearing castings which are used in a babbitted bearing to really carry the load which would be too heavy for the babbitt alone. These bronze bearings get hot and at times crack up into many pieces, although they are lubricated, and also cooled with water. What mixture of metal would you suggest for this class of bearings? While these bearings get hot we do not think it is this class of bearings that is referred to as hot mill bearings. We would like to obtain the mixture for these hot mill bearings.

The term "hot mill bearing" is applied to those bearings in a rolling mill that are worked above ordinary temperatures. Rolls used on heated metals naturally become hot and the heat extends to the bearings which are of bronze. As bronze rapidly looses strength when heated, it is a problem to get a good bronze bearing for hot neck rolls. The advantage of using lead in a bearing metal is now well known. When used as a hot neck roll bearing some makers imagine that by reducing the lead a stronger bearing will result when heated. With this end in view an alloy, such as the following often is used: Copper, 86 per cent; tin, 10 per cent, and lead 4 per cent. The physical properties of this alloy at 500 degrees Fahr., are tensile strength, 33,000 pounds, elongation, 9 per cent, approximately and that of an alloy of copper 78 per cent; tin 10 per cent; lead, 10 per cent, and zinc 2 per cent, is tensile strength, 32,000 pounds; elongation 10 per cent. The latter alloy is much the better bearing metal. Therefore, there is no sound reason for using the alloy of low lead content for such bearings. The alloy 80 copper, 10 tin, and 10 lead is the standard bearing alloy for shocks and heavy pressures, and is suitable for both hot and cold roll bearings, and even higher lead can be used.

Armature Bearing Babbitt

We would like to receive a formula for a babbitt suitable for motor armature bearings. We are using at present an alloy consisting of tin, 83.33 per cent, antimony 8.33 per cent, and copper 8.34 per cent. However, this is not giving sufficient service.

The alloy in question is considered standard for armature motor bearings. However, as it does not give satisfaction, it would be well to experiment with several alloys. Sometimes a more fluid and satisfactory alloy is found for certain purposes by lowering the copper and increasing the antimony. We suggest an alloy of tin 85 per cent; antimony 10 per cent, and copper 5 per cent be tried first. If this is no improvement, increase the antimony as follows: Tin, 82 per cent; antimony, 14 per cent, and copper, 4 per cent.

Ductile Aluminum Alloy

We would like to obtain a formula for an aluminum alloy that will bend 15 degrees without breaking. The ordinary aluminum alloys used for automobile castings are too brittle for the work we are called upon to do. We will appreciate greatly any suggestions you may have to offer.

The following alloy bends considerably and may be suitable for the castings you desire to make: Aluminum, 92 per cent; copper, 2 per cent; zinc, 5.50 per cent, and phosphor copper, 0.50 per cent. Make a *hardener* of 2 pounds of copper, ½ pound of phosphor copper and 2.50 pounds aluminum, and melt it with 89.50 per cent aluminum, then add 5.50 pounds of zinc.

Color in Brass Castings

We have experienced considerable trouble in getting uniformly colored yellow brass castings for builders' hardware. How can we get the uniform yellow color similar to that of rolled sheet brass? We have tried various mixtures and also have used condenser tubing alone, but with unsatisfactory results.

The difficulty about getting the desired color is due to the use of too much zinc. Condenser tubing is made of Muntz metal as it must be able to withstand hot rolling and a mixture with 38½ parts of zinc in 100 is the lowest that will meet this requirement. Alloys of around 40 per cent zinc are red in color and will not match sheet brass in color. The following alloy will match sheet brass: Copper, 65 per cent; zinc, 32 per cent; lead 3 per cent. For high grade yellow brass castings the following alloy is most satisfactory: Copper, 75 per cent; zinc, 23 per cent; lead, 1.5 per cent, and tin, 1.5 per cent. Condenser tubing can of course be used as a part of these mixtures; but not in entirety as it must be sweetened with copper. If aluminum can be used in the mixtures containing more than 30 per cent zinc, it will greatly aid in running the castings. About 1 ounce of aluminum to 100 pounds of the brass is sufficient.

High Pressure Castings

We operate our own brass foundry making a line of small brass castings for pressure purposes and we would appreciate any suggestions regarding the best formula to use for castings subjected to pressures of 300 tons, also a formula for a flux suitable to use on the same.

In order to withstand a pressure of 300 tons per square inch the castings will require to be designed of the proper thickness. The following alloy can be depended upon as far as the alloy goes. First, make a hardener as follows: Melt tin, 80 per cent; add phosphor tin, 2 per cent, then follow with zinc, 14 per cent and lead, 4 per cent. Stir this alloy thoroughly and run into small ingots or strips. To make the bronze melt copper 87 pounds, and when ready add 13 pounds of the above hardener. Stir the bronze thoroughly before pouring and do not pour when cool. Use charcoal as a covering on the metal with possibly a little sand and borax mixed.

Protest Proposed Duty on Plumbago

Manufacturers of Foundry Facings and Graphite Grinders with Users of Crucibles Assert Tariff Measure Would Result Only in High Cost of Plumbago Products

GRAPHITE grinders, makers of foundry facings and crucibles, and other users of plumbago are practically unanimous in putting before the house ways and means committee a vigorous protest against taking plumbago off the free list in drafting a tariff bill to supplant the present Underwood act. The same interests lodged objections against the Fordney bill, proposing a duty of 2 cents a pound on all imports of crude graphite ore carrying 50 per cent carbon and over, and a duty of 6 cents a pound on all crystalline graphite that will pass through a ¼-inch screen. The latter bill was vetoed and failed of passage in the closing hours of the Wilson administration. In both instances it is contended that no duty would be high enough to turn crucible and facing makers from Ceylon graphite to the Alabama product, and the only result would be to force crucible and facing prices to unreasonable heights. The defense for the Alabama interests, urging that the wartime industry be saved to the nation, has been put forward by George A. Sharpe, Ashland, Ala., chairman of the mineral section of the Southern Tariff association. Some interests, especially those affiliated with the Plumbago-Graphite Grinders of the United States, have aimed their attack at the Fordney bill. Fear is expressed that Chairman Fordney will incorporate in the proposed new permanent tariff bill the duties he proposed, in January, 1920, in his emergency tariff act.

Seven indictments against the proposal to impose a duty on graphite have been returned by the Plumbago-Graphite Grinders of the United States, whose membership includes Frederic B. Stevens, Cummings & Moore, Springfield Facing Mills, J. S. McCormick Co., Hill & Griffith Co., John Hill Foundry Supply Co., Columbia Facing Mills, Smith Facing & Supply Co., S. Obermayer Co., T. P. Kelly & Co., Asbury Graphite Co., Bloomsburg Graphite Co., J. W. Paxson & Co., George E. Pettinos, C. F. Pettinos, Federal Foundry Supply Co., Whitehead Bros. Co., E. J. Woodison Co., and J. L. Prescott Co.

Dissecting the duties of 2 and 6 cents a pound proposed in the Fordney bill, the association asserts:

"The net result is that a duty of 6 cents a pound is proposed on foundry graphite or plumbago that at present sells for from 2 to 4½ cents a pound, *c.i.f.* New York, or *f.o.b.* Canadian shipping points, and as against a prewar price of from 1¼ to 2 cents a pound.

"The motive is to force the plumbago grinders who are signers of this petition to purchase the large stocks of unmarketable domestic graphite which could not advantageously be utilized in the production of satisfactory graphite facings and foundry plumbago during perwar days, because of their utter unfitness for such purposes, although offered to the signers of this protest by the producers as low as ¾ cent a pound. In spite of the unfitness of this graphite, the Alabama producers propose forcing the consumption of these commercially by means of this prohibitive tariff wall of 6 cents per pound which would, if enacted, push the cost of Ceylon and Canadian graphite dust up from present prices obtaining of from 2 to 4½ cents per pound, or an average advance of over 300 per cent.

"The extremely low grade quality of the great bulk of Alabama and Pennsylvania graphite dust, due to the presence of a heavy proportion of silica, mica, and quartz has always been the prohibitive factor in their use in the production of satisfactory foundry facings and plumbagos. The presence of this large percentage of foreign matter minimizes the desirable effect of refractory graphite, and this silicious material fuses under the pouring heat of the molten metal, thereby defeating the very object sought in the use of graphite in foundry practice."

Users Would Be Affected

According to John A. Mathews, president of the Crucible Steel Co. of America, the proposed 6-cent duty would "mean an increased cost in terms of finished crucible steel of from $9 to $10 a ton, leaving out of consideration the lowering in the quality of crucibles which would result from the use of domestic flake graphite. The placing of a tariff of nearly 75 per cent on the present market prices would be a serious detriment not only to ourselves but also to other manufacturers of crucibles.

"This material," Mr. Mathews concludes, "should be kept on the free list, or at the most protected in a small amount, such as 10 per cent, for revenue purposes."

James M. Westgate, treasurer and general manager of the Bay State Crucible Co., Taunton, Mass, says:

"A tariff on graphite will not give any protection to the American miner of graphite because it is impossible to make a good crucible without the use of the Ceylon variety. The only result will be to advance the price on crucibles. Crucible makers are just beginning to get their graphite at somewhere near prewar prices, and if permitted to continue along under prewar conditions, they will use just as much American graphite as they would under a tariff, and be able to prosper in a line of industry to which they have given their life's work."

Charles E. Kern, Washington, representing "men who supply manufacturers of graphite products with their materials, domestic and imported," pointed out that for 50 years graphite deposits in the United States have been known, yet in all that period Ceylon graphite has sold uniformly for an average of 50 per cent over the price of Alabama graphite. A telling point brought out by Mr. Kern was that importations of Ceylon graphite are giving return cargoes for American ships trading with the Orient.

"Only a very small proportion of domestic graphite can be used in the various crucible mixtures with any degree of safety, Jonathan Bartlay, of New York, representing the manufacturers of graphite crucibles, told the committee. Pointing out the pronounced difference in the physical properties of the American and the Ceylon flake, he noted that the American is much thinner, more flat on the surface and lighter in specific gravity. Consequently, he said, it requires fully 10 per cent more clay binder to produce a mass which has a density equal to the Ceylon product and this brings in the danger of slow conductivity and readiness to absorb moisture. The proposed duty, he maintained would levy an assessment of $2,000,000 annually upon the 13 crucible plants in the United States.

Malcolm McNaughton, representing the Joseph Dixon Crucible Co., Jersey City, N. J., laid much stress upon the point that the crucible business of the United States is much more important than the graphite-mining business and hence should receive major consideration. He filed with the committee a brief, urging that the classification be retained as it is in the Underwood tariff —as plumbago and on the free list. This brief was signed by the following manufacturers of crucibles: Jonathan Bartlay Crucible Co, Trenton, N. J.; Bay State Crucible Co., Taunton,

(*Concluded on Page* 249)

Cost of Synthetic Gray Iron Low

Gray Iron from the Electric Furnace Now Being Used for Many Types of Castings—Synthetic Iron Made from Steel Scrap Cheaper Than Electric Furnace Metal from Iron Scrap

BY R. C. GOSROW

SINCE the electric furnace as a metallurgical apparatus has demonstrated certain advantages in the production of steel and steel castings, engineers have attempted to produce similarly improved results in melting cast iron electrically. For several years no wide changes in the general design of equipment for producing iron castings, has taken place. New iron mixtures have been developed, resulting in improved properties to the iron produced, but the equipment has had no marked change.

When the electric furnace was initially introduced to metallurgy on a practical scale, it was applied primarily and principally to steel making, as a remelting unit. It was not primarily considered as a unit for the production of gray iron. The cupola was filling this role, and was accepted as producing a satisfactory metal.

In 1914 some gray-iron castings were produced in electric furnaces by remelting iron scrap. A small plant in the west produced many tons of iron castings as emergency required. These castings were produced by remelting good gray-iron scrap, and building up the constituents as desired. About 1916 several plants throughout the country were producing gray iron, electrically melted, for castings. Most of such plants were making castings from gray-iron scrap and pig metal. Melting steel scrap for washed metal was practiced in 1917 at an eastern plant. Several heats of synthetic iron were produced, also, and cast into metal for ingot molds. These were produced partly from virgin pig, and partly from steel scrap. In 1918 the synthetic iron process and the production of gray-iron castings from iron scrap and pig metal became established in several plants.

COSTS of any operation always are relative, depending on a number of variables which differ according to time and location. Castings can be made one year cheaper than another, and in one section of the country costs may be much higher for one operation than they are in any other locality. However, detailed costs do tell a definite story which can be a guide to the executive who is able to interpret them. The costs in this article are accurate for the time and place stated and give significant figures showing relative values for a process now coming strongly to the attention of foundrymen.

The process and methods of producing in the electric furnace the various foundry irons for castings may depend on the availability of raw materials; cost of various raw materials; cost of labor; and the grade of iron desired in the castings. The following is a resume of processes which may be so used.

Cold melting iron-foundry scrap. Adding alloys cold with the charge.
On an acid hearth.
On a basic hearth.
Cold melting steel scrap. Adding alloys when melted.
On an acid hearth.
On a basic hearth.
Cold melting steel-making pig. Adding alloys with charge if melted, in the furnace.
On an acid hearth.
On a basic hearth.
Finishing hot cupola metal, and adding alloys, cold or melted, in the furnace.
On an acid hearth for high silicon irons.
On a basic hearth for low silicon irons.
Finishing hot steel metal and adding alloys cold or melted, in the furnace.
On a basic hearth.
On an acid hearth.

The electric furnace iron has advantages, which had been apparent in those works where the furnace has been put to such production. One large manufacturer in the East uses the electric furnace for the production of high-pressure hydraulic and steam fittings In this case the electric furnace product was adopted on account of its greater density and strength. Castings made from electric furnace iron

Table I

Cost of Electrically Melted Gray Iron Produced From Iron

Item	Quantity	Unit cost	Per 20 tons
No. 1 iron scrap	1.08 N. T.	$45.00 N. T.	$ 972.00
Limestone	50 lbs. per ton	4.00 N. T.	2.00
Fluorspar	6 lbs. per ton	25.00 N. T.	1.50
Carburizer			
Coke, Coal, Coked gas carbon, Ground electrodes	average		12.00
Ferromanganese	8 lbs. per ton	5c lb.	8.00
Ferrosilicon	60 lbs. per ton	5c lb.	60.00
Power (cold melt)	450 Kwhrs.	1½c Kwhr.	135.00
Electrodes (graphitized)	15 lbs. per ton	23c lb.	69.00
Linings			
Walls			6.00
Hearth			4.00
Roof			6.00
Lining repairs			
Banking materials			7.00
Roof patching			3.00
Spout and slag doors			4.00
Ladle lining			4.00
Ladle drying			6.00
Furnace tools, etc			5.00
Labor			
Metallurgist and superintendent, 30 per cent time at $500 per month			16.66
Head melter, two work 8 hours at $6 per day			12.00
Helper, four work 8 hours at $4.50 per day			18.00
Furnace floor labor, two work 8 hours at 40c per hour			6.40
Ladle pit labor, two work 8 hours at 40c per hour			6.40
Ladle liner, two work 8 hours at 50c per hour			8.00
Scrapyard labor, two work 8 hours at 40c per hour			6.40
Shop labor			5.00
Chemist and laboratory supplies, $200 and $50 per month			8.33
Unproductive payroll			2.00
Depreciation furnace equipment 10 per cent per year			11.65
Amortize fce. investment in 10 years. Amort. Fund			11.65
Interest at 7 per cent year			8.16
Insurance			1.80
Total			$1426.95
Average per net ton			71.35

This estimate does not cover carrying charges on raw materials in storage, or market risks on the product.

are less frequently permeable to liquids under pressure than the cupola iron formerly cast.

Electric furnace iron also is being used in gray-iron foundries for the following castings:

High pressure steam valves and fittings.
Superheated steam valves and fittings.
Locomotive cylinders.
Internal combustion engine cylinders.
Internal combustion engine piston rings.
Hydraulic intensifier castings.
Hydraulic valves and fittings.
Hydraulic pumps and rams.
Machinery parts exposed to heavy compressive and transverse stresses.
Chemical and metallurgical equipment for noncorrosive metal mixtures.

The variables, as previously noted which govern the method of production as well as the cost of electrical power, also control the cost of iron for castings to a large extent. Therefore costs will vary widely under different conditions. The estimate in Table I is based on July 1920 conditions on the Pacific coast, and gives figures for a basic hearth operation using iron-foundry scrap. This estimate shows the cost to be high for straight melting of iron scrap, and is given to compare with the steel-scrap melt shown in Table II. Both were calculated for the following conditons:

Analysis of iron desired for machinery castings up to 200 pounds:

	Per cent
Silicon	3.20–3.75
Sulphur	0.25–0.40
Phosphorus	0.040 max.
Manganese	0.055 max.
Total carbon	1.75–2.25

Furnace capacity—metal production—20 tons per 16 hours. Three ton, 3-phase furnace.
Power capacity of furnace—750 kilowatts.
Furnace process—Basic hearth.

The estimates in Tables I and II indicate the economy of the synthetic process, by using steel scrap and building up the carbon and silicon. The figures show the main difference in the costs of the two processes is in the costs of the charges. With iron scrap the metal charge costs $972.00 per 20 tons, equal to $48.60 per ton, while the metal charge for synthetic gray iron cost $418.00 per 20 tons, or $20.90 per ton.

The electric furnace is readily adaptable to the production of iron for castings. The possible control of the furnace temperatures, prevents excessive and wasteful use of the electrical energy. The controllable atmosphere of the melting and refining periods prevents excessive metal oxidation and loss of alloys, and also prevents an increase in sulphur as is the case with cupola melting, allowing the use of scrap with higher sulphur.

Frederic B. Stevens, Detroit, has leased a new warehouse on Twelfth street, Erie, Pa., to which they will remove the stock at present carried in the warehouse at West 19th St.

Proper Size of Blower Important Factor

Question: We should like to know what is the proper size blower for a cupola 36-inches inside the lining. What size should the outlet be made, at what speed should it run and what power would be required to drive it. We should also like to know how many cubic feet of air are required by a 36-inch cupola. At what pressure should this air be supplied to a cupola provided with six 6-inch tuyeres. What effect will it have on the iron or on the castings if a 36-inch cupola is supplied by a 30-inch blower with a 6-inch outlet and speeded up enough to melt hot iron. The charge consists of good machinery scrap or part scrap and part pig and good coke?

Answer: Nearly all the points raised in your inquiry are covered in an article entitled "Cupola practice is not consistent" which was published in the Sept. 1 issue of THE FOUNDRY.

There is no standard size universally adopted by all makers of foundry blowers and therefore it is impossible to specify the "size" blower best adapted for a 36-inch cupola. Different makers have different systems for numbering their product and a No. 4 by one maker might well be a No. 3 or a No. 5 by another. Again, centrifugal blowers, positive pressure blowers and fans all are built along different lines and are numbered according to different systems.

Without a catalog of the maker which shows the capacity of each blower and the corresponding number, the only way to order a blower is to specify a machine that will deliver a given quantity of air in a given time, usually reckoned by the minute.

It is a fairly well established fact that 30,000 cubic feet of air are required to melt one ton of iron. It also has been established in a fairly satisfactory manner that a furnace should melt 10 pounds of iron per hour for every inch of horizontal area at the melting zone. With these two factors to build on it is an easy matter to determine the size of the required blower. In other words find out how many cubic feet of air the cupola needs an hour to operate to capacity and then install a blower which the maker guarantees to deliver that quantity.

At the present time the various blower makers have such a mass of data and statistics on the subject that the prospective customer only needs to mention the inside diameter of the cupola and the manufacturer stands prepared to supply the proper size fan together with all the accessories.

By employing the formula mentioned you will find that a 36-inch cupola (inside the lining) has an area of 36 x 36 x 0.7854, or 1017.87 inches. Multiplying this by 10, we find that the cupola should melt 10,178.7 pounds of iron an hour. Roughly speaking this is 5 tons. Now since it is necessary to supply 30,000 cubic feet of air to melt 1 ton of iron it follows that the blower for a 36-inch furnace will have to deliver 30,000 x 5 cubic feet of air an hour. That is 150,000 cubic feet an hour or 2500 cubic feet a minute.

A blower with a 6-inch outlet is too small for a 36-inch cupola. In order to deliver a sufficient quantity of air through a 6-inch pipe it would be necessary to drive the blower at a dangerous and prohibitive speed.

It is well to remember that volume of air and not pressure is required and there is no sense in inviting pulley and belt troubles trying to get extra speed out of a small fan when a

Table II
Cost of Electrically Melted Gray Iron Produced From Steel

Item	Quantity	Unit cost	Per 20 tons
Steel turnings, Shear scrap, Forge flash, Stamping scrap	1.10 N. T.	$19.00	$418.00
Fluxes, etc.			4.00
Carburizer (gas carbon)			14.00
Spiegel (carburizer and manganese)	45 lbs.	1.75c lb.	14.00
Ferrosilicon, 50 per cent alloy	85 lbs.	4.50c lb.	76.00
Power	450 Kwhrs.	1½c lb.	135.00
Electrodes (graphite)	15 lbs. per ton	23c lb.	69.00
Linings			8.00
Lining repairs			8.00
Ladle repairs			4.00
Ladle heating			5.00
Furnace tools			5.00
Labor, chargeable to furnace and production			77.00
Depreciation, amortization, interest, insurance, etc			20.00
Totals			$857.00
Per net ton average			42.85

larger fan could be operated at a slower speed, at the same consumption of power and deliver the required volume of air at a suitable pressure, in this instance about 10 ounces. A fan suitable for a 36-inch cupola should be provided with about a 12-inch outlet and would require a 20-horsepower motor to run it at a speed of 2000 revolutions a minute.

A prominent maker of pressure blowers for foundry use recommends the following for a 36-inch cupola: Diameter of outlet, 14 inches; blower speed, revolutions per minute, 230; cubic feet per minute 2650; brake horse power of motor up to 1 pound pressure, 15. We do not think that a blower with a 6-inch outlet could be speeded up sufficiently to supply a 36-inch cupola, but even ii it was it would have no appreciable effect on the iron. The initial pressure developed in going through the 6-inch outlet would be neutralized by the six 6-inch tuyeres. Air driven into a cupola under high pressure will exercise an oxidizing effect on the iron in the charge; but this only takes place when other factors are favorable. Volume must be present as well as pressure, otherwise the pressure is dissipated once it enters the cupola. The bed must be low to allow the air to come into contact with the iron. If the bed is of the proper neight the oxygen from the blast will all be absorbed by the fuel before it reaches the iron charge and thus the iron will not be oxidized.

It is possible of course to drive air into a cupola at a pressure and in sufficient volume to oxidize the iron; but you cannot drive enough air through a 6-inch pipe into a 36-inch cupola to do it. You are far more likely to experience slow melting with the attendant danger of a hang-up on account of insufficient air being supplied.

Pattern Record System Prevents Mistakes

BY M. E. DUGGAN

WHEN a pattern is wanted you call upon the man in charge of the pattern storage loft, who probably has held down the job for the preceding 10 or 12 years. He knows every pattern, what it is for and where it can be found. That is, if it is in the pattern storage. If it cannot be found in the loft it must be in the foundry. Where else could it be? Who is prepared to dispute the point? There are no records except such as he keeps for his own information and they generally are of no value to an outsider.

Any person who has ever tried to get a pattern in a place where no record is kept and in the absence of the man in charge knows what a practically hopeless job it is. You may be told what the pattern looks like or perhaps have been shown an old casting made from it. There is no indication of the number of loose pieces or coreboxes belonging to the job. After a diligent search in the pattern storage you will probably find several patterns that conform in a general way with the one you are in search of. They probably will differ in some detail from each other; but think of the wasted time and effort in checking them all. What you are doing is all guess work.

A poor record system is as bad as none. In one shop where I was employed what might be called an excuse for a record system was kept. In that shop as many as two and three duplicate patterns were made in some instances. Where correct records of patterns, coreboxes, loose pieces, etc., are kept, mistakes are few and there never is any trouble experienced in getting any pattern at any time by any person.

The card shown in the accompanying illustration is the basis of the best pattern storage system I have ever seen. If this record is properly filled out, any man or boy can, in a year or ten years from now, find any pattern he wants, and not only find the pattern but also find all the data in connection with that pattern from the time it was ordered until the time he gets the card.

With possibly one exception the system is fool proof: It does not keep persons out of the pattern storage who have no business there, and prevent them from upsetting the whole system by attempting to find a pattern or a part of a pattern without consulting the records.

The items shown on the pattern-record card in the illustration are: Name of casting, and number of the blueprint. If a blueprint was given the patternmaker then the item is checked off followed by the word *shop*. The blueprint number in this instance is 345-8D, which means that 345 is the number of the job; 8 is the number of the sheet; D is the piece or part on that sheet. The figures, 5-6-20, indicates the date on which the drawing was finished. If a brown paper drawing a free-hand sketch, or verbal instruction is given the patternmaker, the same is indicated by a check mark followed by the initials of the man who made the drawing or of the foreman of the department where the drawing came from. The value of the information contained in this item will be apparent in a month or two, or a year or more after it is entered when the job is forgotten by every person who has had anything to do with it. A second casting may be wanted in a hurry. The necessary information is right there on the card and it is not necessary to look through a multitude of drawers containing stacks of blueprints when the drawing needed is on brown paper or a free-hand sketch filed away on a spindle; or perhaps just a verbal instruction from the foreman of some department had been given.

In the second column we find that the casting called for is *lower journal*.

BRASS LINER.				LOWER JOURNAL		No. 16 ROLL.	
NAME OF CASTING				FOR		MACHINE.	
Blue Print No. 345-8d				Pattern Made	5-20-20	Serial No. of Pattern.	4227
Date of Drawing	5-6-20			Loose Pieces on Pattern.	8	Stock Pattern.	
Brown Paper Drawing				Core Boxes.	3	Section Pattern Loft.	26
Free Hand Sketch.				Loose Pieces in Core Box.	6	Shelf in Section.	8
Verbal Instructions				Stock Cores. A B C D.	4	Pattern Charge No.	18.20.24
CASTINGS ORDERED				CASTINGS REC'VD		PATTERN	MISSING
Date.	Pieces.	Material.	Foundry.	Date.	Pieces.	At.	Date.
5.22.20	25	Brass	Jones	5.25.20	7	Jones Fdy.	5.25.20
				5.27.20	8	" "	5.27.20
O.K. 5.30.20				5.28.20	5	" "	5.28.20
				5.30.20	5 Total 25	Recv. Room	5.30.20
8.15.20	25	Brass	Jones			Jones Fdy.	8.15.20

O.K. 6.2.20

Loose Piece in Core Box.

SPECIMEN CARD CONTAINING SIMPLE, CLEAR AND CONCISE DATA IN CONNECTION WITH A GIVEN PATTERN

The figures 5-20-20 indicate the date upon which all the patterns were finished. The succeeding items show that there are 8 loose pieces on the pattern, besides 3 coreboxes and 6 loose pieces with the coreboxes. We also find that stock cores are to be used at *A*, *B*, *C*, and *D*. These letters were stamped on the prints either by the patternmaker or by the man in charge of the pattern storage.

In the third column is entered the name of the machine or unit of which the casting forms a part. In this instance it is No. 16 Roll. The figure, 4227, is the serial number of the pattern. On the line below, marked *Stock Pattern*, is indicated whether the pattern was a regular stock pattern from which to make several castings, or if it was a special pattern to make just one casting. The concluding items on this section of the card show that the pattern is stored in section 26 on shelf *B* in the pattern loft. The last item, 18-20-24, is the pattern charge number. All work on the job is charged to this number; 18 is the number of the department; 20 the group of machines, and 24, the individual machine.

Additional information entered on the lower part of the same card embraces data covering the time castings were ordered and received and also the location of the pattern at any given time. The last column is used to check the patterns and loose pieces when the order has been completed.

The cards are kept in indexed filing cabinet and grouped according to plant departments. A small index card 3 x 5 inches containing the serial number and the name of the part is filed in a separate drawer and indicates exactly where the large card can be found.

Runs Four Heats a Day in Small Cupola

An experience I had some time ago seems to indicate that a practical foundry knowledge is necessary to meet an emergency. I received an order for 72 castings like the one shown in the accompanying illustration and was told they were wanted in the shortest possible time. The job was part of the equipment for shipping wire in bundles. It was a half sheave and was to be bolted onto another whole sheave or spool to increase its wire carrying capacity.

The job had been given to an outside foundry in the first place which promised to make delivery of 10 castings a week. However, the promises failed to materialize, only two castings reaching our machine shop in three weeks and they were too hard to be machined. It was quite evident that if I had 72 flasks, half a dozen follow boards and patterns and about a dozen molders, I could make all the castings in one day. It would also mean that the cost of the patterns, flasks and follow boards would be out of all proportion to the cost of the castings. I decided then to make six flasks, two patterns and two follow boards and to pour six molds several times a day. The carpenter made the flasks and the follow boards as shown in the illustration and the following morning I picked two molders and a helper, explained the details and we started.

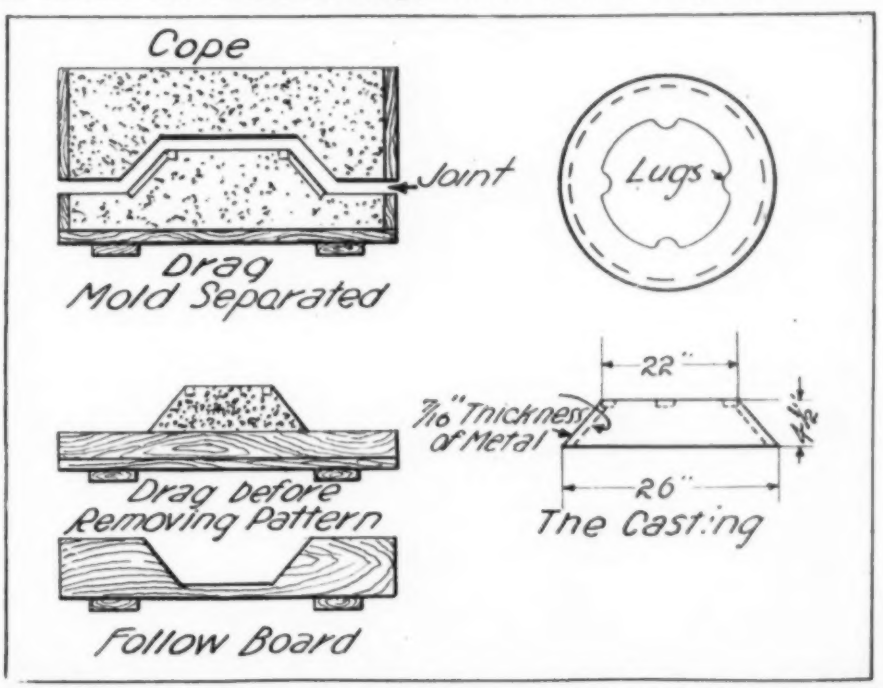
On the first day we poured two heats making 12 castings and we had two molds ready for the next day. The second day we poured 18 castings and had four ready for the next day. The third day we poured 24 castings and rammed up three for the following day and on the last day we poured 20 castings. This was two in excess of the order and was made necessary because one casting was broken in the machine shop and a drop spoiled one in the foundry. The total cost was 25 per cent less than the firm was paying for its castings in the open market at the time.

The cupola used was 26 inches inside diameter by 84 inches above the bottom plate. It was provided with four tuyeres each 2 inches in diameter. The blast was furnished by a Sturtevant fan at 6½ ounces pressure. The cupola was made ready the first day at 9:30 a. m and 350 pounds of coke was placed on the bed. The fan was put on for about 15 minutes to accelerate the burning. When the bed was burned up properly the fan was shut off and the charge, consisting of 25 pounds of coke, 25 pounds of crushed limestone and 300 pounds of iron was dropped in. The fan was started again and left running until all the iron was melted, when the wind was shut off until the next set of molds was ready. The cupola then was recharged in the same manner as at first.

After each heat the flasks were shaken out and the sand tempered. On the second, third and fourth days the cupola was made ready at 8 a. m.

Will Sell Directly to Grinding Machine Trade

The Norton Co., Worcester, Mass., will sell its grinding machines directly to the trade and not through jobbers, as has been the custom since the establishment of this division of the company. Contracts with dealers have been closed, and in the meantime agencies have been established by the company in the chief distributing centers of the country. The exceptions to this rule are the Pacific coast and the extreme south. The New England territory will be covered from the main office. The new district managers are: New England, George C. Montague; New York, Harry Harding, recently European representative who has been brought back to America; Chicago, Hiram N. Cudworth; Detroit, Oscar Knight; Cleveland, Oscar E. Nordstrom; Pittsburgh, Paul R. Hawkins; Philadelphia, Paul Hoffman. The other offices will be in charge of district agents as follows: Indianapolis, Walter Rogers; Syracuse, Walter Cook; and Hartford, Conn., Henry Peckham.



METHOD OF MOLDING A HALF SHEAVE TO INCREASE THE CAPACITY OF A WIRE SPOOL

THE FOUNDRY

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Contents

Bell Molds Made of Loam on Arbors.....211
French Not German Machines—A Correction.....215
Electric Furnace Improves Gray Iron.....216
Quality Secured from Converter Process.....218
To Manufacture Furnaces.....218
Proved Design for Ladle Stopper.....219
Cast Iron Research in Great Britain.....222
How to Get Back to Normal Quickly—II.....223
Revise Safety Code for Grinding Wheels.....224
Correcting Flaws in Metals and Mixes.....225
Prevent Piston Castings from Cracking.....225
Function and Application of Skim Gates.....225
Produce Detail in Castings.....225
Amounts too Small for Cupola.....225
Combining Malleable and Gray-Iron Work.....225
Bill Reviews the Sheave Wheel Problem—I.....226
Blames Cancellations for Disturbed Business.....228
Manufactures Gaggers.....228
Industrial Relations Departments.....229
Specializes in Electric Heating Problems.....231
Artificial Loam Mixtures.....231
Keep Foundry Equipment Repaired.....232
Book Review.....234
A Correction.....234
Grate Bar Company Reorganizes.....234
Analyze Loss in Aluminum Shops—VII.....235
How and Why in Brass Founding.....239
Using Aluminum Additions in Yellow Brass.....239
Die Casting Lead Sheets.....240
Hot Mill Bearings.....240
Armature Bearing Babbitt.....240
Ductile Aluminum Alloy.....240
Color in Brass Castings.....240
High Pressure Castings.....240
Protest Proposed Duty on Plumbago.....241
Cost of Synthetic Gray Iron Low.....242
Proper Size of Blower Important Factor.....243
Pattern Record System Prevents Mistakes.....244
Runs Four Heats a Day in Small Cupola.....245
Will Sell Directly to Grinding Machine Trade.....245
Foundry Engineer a Modern Product.....246
Trade Outlook for the Foundry Industry.....247
Comings and Goings of Foundrymen.....248
Discusses Problems of Bureau of Standards.....248
Announces Generous Gift to Foundry Industry.....249
Gas Furnaces Discussed.....249
Chooses New Officers.....249
W. W. Sly Company Reorganizes.....249
Speak on Pipe Problems.....249
Invents a New Type of Squeezer Machine.....249
Builds Large Sand-Blast Barrel.....250
No Standard Practice for Welding Established.....250
Obituary.....250
Equipment Demand Continues Slack.....251
What Foundries Are Doing.....251
New Trade Publications.....252

Foundry Engineer a Modern Product

IT HAS been said, and there seems to have been considerable justification for the saying, that there is a reason for everything. However, the reason is not always readily apparent and sometimes one has to look a long way to find it. Again, many reasons which should be apparent, remain hidden indefinitely owing to that peculiarity of human nature which leads along the path of least resistance and also on account of the homage which the average person pays to custom and tradition. Consider the niche in the foundry industry occupied by that essentially modern product, the foundry engineer. It is a moot question whether the foundry engineering specialist is responsible for the rapid development of the foundry industry in recent years or whether the expansion and growth of the industry is responsible for the engineer. The fact remains that he is here and whether he is, or is not, responsible for all the improvements in the industry, it must be admitted that he had a hand in designing and developing most of them.

The trend of the foundry industry, in common with others, is more and more toward specialization. Therefore, it follows that there is a legitimate field for members of the engineering profession to specialize, not only in design and construction of the building, but also in methods tending toward increased production and economy of operation within the plant. The onward march of human progress and pressure brought to bear upon the legislative branch of the government has brought about many sanitary regulations in castings manufacturing establishments. Ventilation has to be provided according to certain codes, dust arresters installed and an endless number of such problems met. These innovations introduced additional factors into the design of an economical and efficient foundry. At present a well defined opening is at hand for the man who is able to work with the structural engineer, the mechanical engineer and at the same time be competent to meet the conditions arising from the safety, health and labor codes in the various communities and states. A man qualified to act as a clearing house for useful information, one who could take the owner's problem and solve it should be available.

A great many still believe that the foundry engineer's knowledge does not need to extend beyond the points already mentioned, but there are others who believe that in addition to this he should have a thorough knowledge of foundry practices including those connected with metallurgy. He also should have knowledge of the mechanical operations involved in making cores and molds. It is certain that the possession of such details enables the engineer to render more adequate service in his chosen field and gives him a prestige among those engaged in the casting industry.

A superintendent or foreman who may be in the employ of a company is limited in experience in a comparatively small number of plants. On the contrary, a duly qualified foundry engineer, from the very nature of his profession is a man of broad experience and constantly is in touch with a wide variety of plants the country over. He is in position to bring to the foundry owner a mass of information far in excess of that which could be obtained from any consultant in a general field or an engineer familiar only with building and material handling problems not connected with the actual production problems peculiar to the foundry industry of the country at the present day.

Trade Outlook of the Foundry Industry

PRICE reductions which characterized all of February and the first week of March have had but little effect in stimulating buying. It is pointed out that discrepancies exist between the different commodities, when they are compared on the basis of the ratios between their several production costs and selling prices. In other words, a greater decline has taken place in some basic products, notably farm produce, cotton and wool, than is discernable in others, such as pig iron, semifinished and finished steel products.

Reductions Favorable

Perhaps in the disproportionate reductions, those which have dropped more rapidly have reached too low a plane. Again, it is possible that a still further recession in those which occupy the higher level will have to result before an equilibrium is established. In either event, a more equitable distribution of the losses incident to falling prices is sought by many before taking the initiative in starting their establishments. The manufacturer feels that labor and the retail trade both should reduce their prices in keeping with the adjustment which has taken place in producing lines. Labor demands a still further reduction in living costs before accepting curtailment in wages. The retailer wishes to cut down his stock before making reductions in keeping with the new wholesale price levels. Finally, the consumer in practically every line is observing these commodities which he feels have not yet reached the low point, and is cannily refraining from buying until he is satisfied that the new level is established and the adjustment is completed. These factors all play such a strong part in the present industrial and business situation, that little hope is expressed for a substantial betterment until a full adjustment is completed.

Prices of Raw Materials for Foundry Use

CORRECTED TO MARCH 8

Iron		Scrap	
No. 2 Foundry, Valley	$26.00 to 27.00	Heavy melting steel, Valley	$15.00 to 15.50
No. 2 Southern, Birmingham	26.50 to 27.00	Heavy melting steel, Pitts.	15.00 to 16.00
No. 2 Foundry, Chicago	26.00 to 28.00	Heavy melting steel, Chicago	13.00 to 13.50
No. 2 Foundry, Philadelphia	26.00 to 29.54	Stove plate, Chicago	18.50 to 19.00
Basic, Valley	25.00	No. 1 cast, Chicago	19.00 to 19.50
Malleable, Chicago	26.50 to 28.50	No. 1 cast, Philadelphia	22.00 to 23.00
Malleable, Buffalo	27.50 to 28.50	No. 1 cast, Birmingham	21.00 to 23.00
Coke		Car wheels, iron, Pittsb'gh.	20.00 to 21.00
Connellsville foundry coke	$5.00 to 6.00	Car wheels, iron, Chicago.	18.00 to 18.50
Wise county foundry coke.	6.50 to 8.50	Railroad malleable, Chicago	16.50 to 17.00
		Agricultural mall., Chicago.	16.50 to 17.00

Freight Rates Retard

The far reaching effect of the business depression is graphically shown by the number of idle cars in the freight yards throughout the country. It is estimated that there are over 400,000 idle cars at this time, where only a year ago a shortage of 150,000 cars was blamed for the inability to get shipments through. Freight rates were increased with the object of providing additional revenue. The belief freely is expressed that the raise in rates is responsible in a measure for the decrease in business handled by the roads, and at the present time the earnings are dropping steadily. One angle of the effect of transportation rates upon the foundry industry is shown in the south. A reduction of 15 cents per hundred pounds on cast iron pipe and proportionate decreases on pig iron immediately resulted in the shipment of about 3000 tons of pipe and iron from the Birmingham district by steamship to California. Pipe manufacturers in general are hopeful that early spring will develop the demand which has been held in abeyance so long. Lines which are affected by the same general conditions as the cast iron pipe industry, notably foundries which make sanitary ware, furnaces, radiators and municipal castings again are starting operation on better schedules than have obtained since last fall. This is true in the East and South alike.

February Hits Low Mark

Pig iron production, insofar as it constitutes a barometer of foundry operations, marked February as a low point. On Feb. 28, only 153 furnaces were in operation, while on the last day of January 184 were in blast, according to figures compiled by *The Iron Trade Review*. This is the lowest number of active stacks reported since November, 1914, when 150 furnaces were active. The total pig iron production for February is given as 1,927,088 tons, which when compared with the January output of 2,414,753 gives a loss of 487,665 tons. The February production of merchant iron was 322,220 tons, which in comparison with the January figure of 474,135 tons gives a loss of 151,915 tons. The February daily average production was 11,507 tons, a loss of 3787 tons or almost 25 per cent as compared with the January daily average of 15,294 tons. A prominent blast furnace interest in Ohio conducted a survey to check the foundry operations as reported from time to time. It was found on an average of almost 150 iron foundries throughout Ohio, Indiana, Michigan, northwestern Pennsylvania and western New York, that they were operating at only 23 per cent of capacity. The rate of operation was lower in those regions which embrace the shops devoted to the automobile industry. These districts, particularly in Michigan were 7 or 8 per cent below the average reported from the other sections. This report is supplemented by the opinion of a prominent producer of automobile castings who states that under the curtailed operation schedules of automotive manufacturers, it will require several months to use up the stock of castings accumulated during the slowing down period. Many jobbing shops in the vicinity of New York are experiencing some improvement. One shop states that while they operated at only 15 per cent of capacity in January, the February rate was 60 per cent.

Nonferrous metal prices, based on the *Daily Metal Trade* quotations for March 8 follow: Casting copper, 12.00c to 12.12½c; Lake copper, 12.75c to 13.00c; lead, 4.15c; Straits tin, 28.00c; antimony, 5.20c; aluminum, No. 12 alloy, open market, 19.50c to 21.00c. Zinc is 4.75c to 4.80c E. St. Louis.

Comings and Goings of Foundrymen

A. E. WALKER, president of the American Malleable Castings association, has been named national councilor of the association to represent that body in the Chamber of Commerce of the United States. The national council of the Chamber of Commerce of the United States consists of one representative each from the more than fourteen hundred commercial and industrial organizations making up the membership. It serves as an advisory body to the chamber's board of directors. The council holds a special meeting preceding the annual convention to pass on the program and select a nominating committee. The councilors also act as chiarmen of delegations representing their organizations.

Norma Snow has been appointed foundry superintendent of the Covel Mfg. Co., Benton Harbor, Michigan.

J. Turner Moore, president of the Reading Steel Casting Co., Reading Pa., has been elected president of the Colonial Trust Co. of that city.

John C. Cornell, president, The Cleveland Flux Co., is spending the winter with his brother George B. Cornell, San Diego, Cal.

C. C. Lee has accepted a position as foundry superintendent of the Stroud Motor Mfg. Association, Ltd., San Antonio, Tex.

Frank Hodson, president, Electric Furnace Construction Co., Philadelphia, has been elected a member of the executive committee of the Philadelphia Foundrymen's association.

G. Walter Sanborn, formerly assistant purchasing agent of the United Engineering & Foundry Co., Pittsburgh has been promoted to be purchasing agent. N. J. Green now is his assistant.

Max E. Boettcher, formerly foundry foreman with the Taylor-Wilson Mfg. Co., McKees Rocks, Pa., has accepted a position with Knott & Harker Co., Beaver Falls, Pa.

Frank B. Gilbreth, consulting engineer, Providence, R. I., is in England for the purpose of demonstrating his methods of motion-study analysis by means of moving pictures at the efficiency exhibition now being held at the Olympia Pavilion, London.

R. J. Wean has resigned as sales engineer with the Pittsburgh office, of the Lakewood Engineering Co., Cleveland, to return to the Aetna Foundry & Machine Co., Warren, O., as sales manager. Mr. Wean formerly was affiliated with the Aetna company in 1919 before it was reorganized.

H. F. Pretorious recently connected with the Dodge Bros., Detroit, and representing them as an inspector of malleable castings has been made chief inspector for the Chicago Malleable Iron Co., Chicago.

J. H. Hammel, until recently connected with the foundry division of the Maxwell-Chalmers Motor Co., Detroit, has been appointed plant superintendent of the Automotive Castings Co., Imlay City, Mich.

Edmund Fitzgerald recently has been appointed assistant secretary and production manager of the Northwestern Malleable Iron Co., Milwaukee. Mr. Fitszgerald was graduted from Yale University and served with the 85th division as captain of artillery.

William M. Weir, who for several years was president of the Canada Foundries & Forings, Ltd., Brockville, Ont., and who was succeeded by Thomas J. Dillon, general manager, has again been made president following the retirement of M. Dillon.

J. W. Wolff has been made superintendent of the Benton Harbor Casting Co., Benton Harbor, Mich. Mr. Wolff formerly was foundry superintendent of the Illinois Malleable Iron Co., Chicago, and later was connected with the Covel Mfg. Co., Benton Harbor in the same capacity.

T. D. Dillon has resigned his position as president and general manager of Canada Foundries & Forgings, Ltd., with plants at Brockville and Welland, but will continue to take an active interest in different lines of steel products in Welland and the Niagara district.

James Arnold, recently appointed a director and general manager of Canada Foundries & Forgings Ltd., was formerly assistant general manager at Brockville, Ont. He was at one time a resident of Montreal in connection with the wholesale hardware trade and during the war held important positions with the Imperial Munitions board at Ottawa Mr. Arnold is also vice president of the Mann Axe Co. Ltd., of St. Stephen, N. B.

A. S. Baldwin has resigned his position as manager of ordnance and chief engineer of the Poole Engineering & Machine Co., Baltimore, Md. During the war Mr. Baldwin was in charge of all munition work of the Poole company and during that period developed new guns and special ammunition. He designed a special automatic gun for aircraft armament and also a 3-inch gun for use on submarine chasers. Mr. Baldwin formerly was manager of one of the Westinghouse plants in Pittsburgh and previous to that was general manager of the Alberger Pump Condenser Co., Newburg, N. Y., and general superintendent of the Driggs-Seabury Ordnance Corp., Sharon, Pa.

George J. Blanton, who for the past four years has been connected with the engineering sales department of the Chain Belt Co., Milwaukee, has been made New York district manager. Before joining the Chain Belt Co., in 1917, Mr. Blanton was associated with the General Electric Co. for eight years. Mr. Blanton is a graduate of the University of Michigan, department of mechanical and electrical engineering, class of 1908.

Discusses Problems of Bureau of Standards

Dr. George K. Burgess, chief of the division of metallurgy, United States bureau of standards, Washington, presented a paper, "The Metallurgical Work of the U. S. Bureau of Standards," at a meeting of the Cleveland chapter of the American Society for Steel Treating on Friday evening, Feb. 25. As guests of the society members of the Cleveland Engineering society, American Institute of Mining and Metallurgical Engineers, American Society of Mechanical Engineers, and Society of Automotive Engineers also attended the meeting. In presenting his paper, which was illustrated with stereoptican slides, Dr. Burgess described the bureau of metallurgy, pointing out particularly the equipment and the range of problems which it can handle. Although the talk was general in character, the speaker devoted considerable time to various types of steel to illustrate the nature of results which might be expected by heat treatments.

The American Foundry Supply, Montreal, Canada, recently has opened a warehouse and has assumed the distribution of fluxes manufactured by The Cleveland Flux Co. C. Drapean is in charge.

Announces Generous Gift to Foundry Industry

The board of directors of the American Foundrymen's association has received a substantial gift to be added to its research fund. H. S. Simpson, president of the National Engineering Co,. Chicago, last month presented $1,000 to the association to be used by the directors of that organization in conducting research work and furthering the advancement of the industry. This sum with other amounts previously available will be used to carry on special research work for the general benefit of all classes of foundries.

Protest Proposed Duty on Plumbago

(*Concluded from Page* 241)

Mass.; Chicago Crucible Co., Chicago; Joseph Dixon Crucible Co., Jersey City, N. J.; J. H. Gautier & Co., Jersey City; Lava Crucible Co., Pittsburgh; McCullough-Dalzell Crucible Co., Pittsburgh; Naugatuck Valley Crucible Co., Shelton, Conn.; Ross-Tacony Crucible Co., Tacony, Pa.; R. B. Seidel, Philadelphia; Robert J. Taylor, Philadelphia; and the Vesuvius Crucible Co., Swissvale, Pa.

"The amount of tariff that we ask, the protection we ask, is not prohibitive, but it does put the American producer of graphite upon more or less an equal footing with his foreign competitor," said Mr. Sharpe, in defending the Alabama producers.

Gas Furnaces Discussed

The advantages and disadvantages of different types of core baking and mold drying gas furnaces were discussed March 9, at the regular monthly meeting of the New England Foundrymen's association. The principal speaker was M. A. Combs, Maxon Furnace & Engineering Co., New York. Mr. Combs' paper touched also on various questions relating to melting nonferrous metals through the use of gas as a fuel.

Chooses New Officers

New officers have been elected by the Metropolitan Brass Founders' association, as follows: President, F. H. Landolt, Penn Brass & Bronze Works, Brooklyn; Vice President, John Hamilton, R. Hamilton & Sons, Inc., Brooklyn; Secretary and treasurer, William E. Paulson, Thos. Paulson & Son, Inc., Brooklyn. Thomas Harper of Thos. Harper, New York, Joseph Bechtold, New York Brass Foundry, New York and Thomas Williams, E. A. Williams & Son, Jersey City, have been elected members of the executive committee. The association during the past year has retained practically all of its old members and has added several new ones. Some time ago it inaugurated the policy of providing at each monthly meeting a speaker on foundry practice also on general trade and business affairs. Officers of the association expect shortly to institute an intensive campaign for the increase of its membership.

W. W. Sly Company Reorganizes

The W. W. Sly Co., Cleveland, recently has reorganized its personnel, without, however, making any change in its ownership or management. R. J. Emerich, previously secretary and treasurer has been appointed president and general manager. George J. Fanner retains his position as vice president; George P. Steele has been appointed treasurer and S. C. Vessy, secretary. The officers previously mentioned, together with Paul Ryan, compose the board of directors of the company. This complete reorganization was made necessary through the death of W. C. Sly, president, and G. K. Fanner, who were murdered by pay roll robbers, Dec. 31, 1920.

The other executives of the Sly company include Frank W. Klatt, factory manager; F. A. Ebeling, sales manager; E. J. Moore, development engineer; R. H. Moore, chief engineer; and L. Bottomley, superintendent.

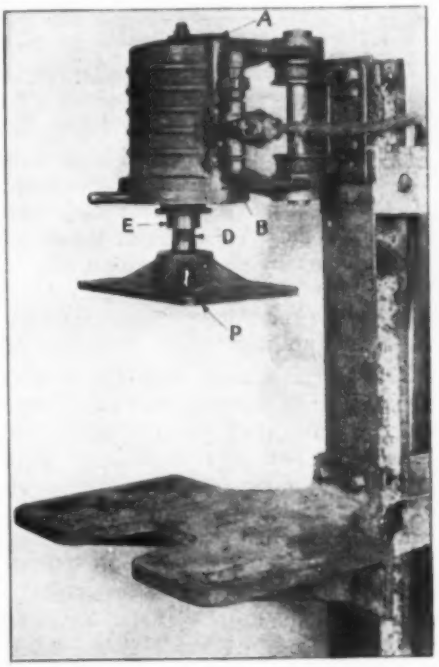
Speak on Pipe Problems

Nicholas S. Hill Jr., New York, consulting engineer, delivered an address on "Pipe Extension Charges," and William R. Conrad, Burlington, N. J., consulting engineer spoke on "Cast Iron Pipe, the Method of Manufacture and its Inspection" at the monthly meeting of the New England Water Works association in Boston, March 9.

Invents a New Type of Squeezer Machine

The power operated squeezer shown in the accompanying illustration and on which A. M. Jones, 333 Cambridge Ave. Milwaukee, has applied for a patent, embodies the same principle and in a measure is a development on the old hand squeezer. Practically all the old original hand machines squeezed the mold with a down stroke. In this new machine the pressure is applied in the same manner. However, compressed air has been substituted for the strength of the molder's arm and the operating mechanism is mounted on a swinging arm so that it readily may be swung either over the mold or to one side out of the way.

It is claimed by the inventor that the machine has been tried out and successfully has made molds. Its simplicity of construction is a feature which will appeal to the foundryman and in addition it is stated that the machine can be sold at a moderate price thus allowing compressed air to be employed at a



THE MACHINE AND BENCH MAY BE ATTACHED TO A SHORT PIECE OF RAIL OR I-BEAM SET UPRIGHT IN THE FLOOR OR TO A COLUMN OF THE BUILDING

figure which will not be prohibitive even to the smallest foundries.

The machine can be made in various sizes to accommodate a great variety of work. Among the advantages claimed by the inventor are the location of working mechanism high above the sand; the comparative ease with which the head is swung from side to side; the convenient height at which the air controlling valve is situated; a semi-floating platen; and a solid, shallow work bench which leaves the floor unobstructed up to the bench height. The rail or I-beam on which the machine is mounted only occupies a 5-inch square floor space.

In practice the air entering at the port *A* will press down the piston which in turn will force the platen *P* down upon the loose sand in the flask. A turn of the controlling valve permits the air to escape from above the piston at the same time admitting air at the bottom of the cylinder through the inlet *B*. Automatically acting plugs catch and

hold the piston in the upper part of the cylinder irrespective of whether the air pressure is applied or not.

The platen *P* is semifloating to take up any discrepancies in the sand level in the flask. The threaded rod *D* to which the platen *P* is affixed fits into the hollow piston rod *E* thereby allowing a considerable vertical adjustment to accommodate molds of various heights. The piston has a 5-inch stroke which together with the adjustment possible on the rod *D* renders the machine available over a wide range.

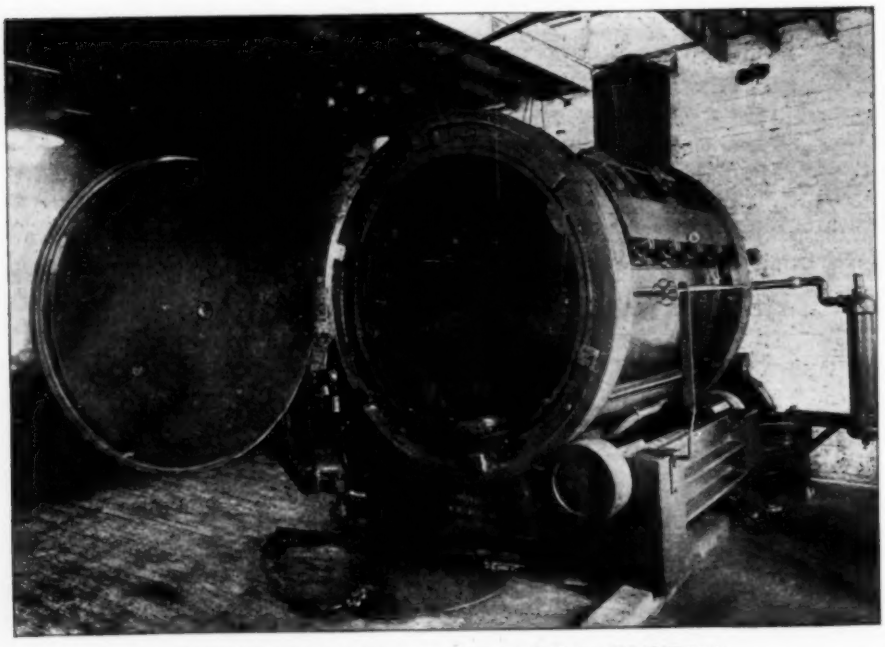
Builds Large Sand-Blast Barrel

One of the largest sand-blast barrels ever produced is being marketed by the Standard Equipment Co., New Haven, Conn. This barrel, shown in the accompanying illustration, is 5 feet inside diameter and 6 feet long. The entire machine weighs approximately 12 tons.

The barrel is made of 1⅛-inch steel plates with heavy cast-steel cleats, and has a ½-inch steel lining plate on the back head and a ⅜-inch steel plate inside the door. The construction of the machine throughout is heavy and it is designed with a view to long life. The barrel is driven with friction rolls with worm gear on each shaft, all enclosed in an oil-tight casing. The pulley on the drive shaft is furnished with a clutch which is operated by the lever shown at the front left hand side of machine. The barrel has 95 cubic feet capacity and will take a charge of approximately three to four tons of castings when charged 2-3 to ¾ full, as is recommended. The barrel is revolved once in 2 minutes.

Each cleat shown inside of the barrel is provided with seven nozzles and each nozzle has a 3-16 inch air nozzle with a ⅛ inch sand nozzle. Only one row of nozzles is operated at a time, as it passes through the blasting zone. The machine requires about 333 cubic feet of free air per minute at 80 pounds pressure. A 5-horsepower motor is supplied to furnish sufficient power to drive the machine. A 10-inch exhaust pipe connection with a vacuum of 2 to 3 ounces for removing the dust is provided.

The machine requires a space of about 6 x 10 x 10 feet. The Standard Equipment Co. recommends placing the machine in a pit so that the inside bottom part of the barrel is about level with the floor. All the bearings on this machine, as well as on other machines manufactured by this company are equipped with grease nipples and a suitable grease compressor with flexible holes for forcing the grease into the bearings is furnished. With this system the possibility of any dirt getting into the bearings is eliminated.



SAND-BLAST BARREL 5 FEET INSIDE DIAMETER

No Standard Practice for Welding Established

Experts in welding, lead burning and other trades requiring considerable manual skill and experience seldom agree on all the points of their respective trades. It is difficult to describe "standard" practice because of the difference of opinions expressed by men who know the most about it. As a matter of fact, hardly any trade practice is fixed and unchanging. New men find out improved methods, and practice them because they save time and exertion, and perhaps produce better work. Torch manipulation is a case in point. Some welders insist on welding prepared joints from right to left, whereas it is believed that the scientific method is from left to right. Some welders who weld in the opposite direction do first-class work, although always working at disadvantage.

In line with the foregoing are the practices of welding cast iron. The practice advised is puddling with the welding stick to work out trapped gas and oxide and to secure thorough penetration. Excellent cast iron welding is performed, however, by experts who do no puddling whatever, but rely on the displacement effect of the molten adding material in the center of the groove to float off the trapped oxide and foreign matter. They skim off the collected oxide at intervals with the welding stick, but do not constantly use the stick as a puddling tool.

Obituary

Bruce E. Fraser of the Frazer Laboratories, Inc., Buffalo, died recently at his home in that city, age 31 years. Mr. Frazer was a son of C. E. Frazer, Chicago. He is survived by his widow, Roberta M. Frazer.

Edwin Jones, president of the Crown Pipe & Foundry Co., Jackson, O., died in a hospital at Columbus, O., Feb. 3 following an operation performed last December. Mr. Jones, who was 58 years old and born in Jackson, was a former chairman of the Republican state executive committee and in 1918 was a candidate for the party nomination for governor.

Guy R. Sperry, president of the Geneva Foundry & Machine Co., Geneva, Ill., died suddenly at the plant Saturday, Feb. 12, of heart disease. His death was entirely unexpected, as no sign of ill health had appeared previously. He was 44 years of age and a brother of the late Burton E. Sperry, formerly mayor of Batavia, and one of the pioneer foundrymen in the Fox river valley, having conducted a foundry for many years at North Aurora. He was born at Batavia, Dec. 18, 1876 and lived there his entire life. He had started the Geneva Foundry & Machine Co., in a small way several years ago and built it up to its present important standing. The funeral, Feb. 15, was attended by more than a score of business men from Chicago, and the pallbearers were employes in the foundry.

Equipment Demand Continues Slack

Slight Acceleration in Foundry Operation in Some Sections Not Yet Reflected in Inquiry for Machinery and Supplies— Buying of Repair Parts Improves

AN encouraging feature is noted in the market for foundry equipment, during the past two weeks. Sales of repair and replacement parts for practically all classes of foundry machinery have increased. This is stated to have been one of the first indications of a return of new inquiry in past periods of slack business, and in this instance is supported by other conditions. Competition has forced many foundries to change the character of the work which their shops produce and to plan more efficient operation. This is bringing a fair amount of inquiry and some orders for new equipment to enable them to change the class of castings which they can make. Light foreign inquiry is reported. A Cleveland manufacturer of sand handling machinery recently has quoted on an Australian inquiry for a large installation.

Change In Output Brings Eastern Inquiry

DUE to efforts of many foundries to broaden their lines, inquiries in the eastern equipment market are more numerous. However, a number of these are for estimating purposes, and as a result no market increase in buying is noted. While various foundries are considering new lines, or additional lines, most of the work in this direction is still to be done, and until sufficient demand for new products has been developed ,there is likely to be little buying of equipment. New projects include several plants contemplated for erection in the southeast, but little actual work has been undertaken. Work on the proposed plant of the Batavia Car Co., Batavia, N. Y., is pending and actual construction has not as yet been begun on the new foundry of the White Fuel Oil Engineering Co., 742 East Twelfth street, New York City. The Standard Oil Co. of New Jersey has decided not to purchase equipment in this country for its proposed foundry in Roumania. It is understood that new inquiries will be issued later, but through the Roumanian offices of the company. A New York seller of foundry equipment has taken an order for five sand grinding machines, and another, for two tumbling barrels. D. F. Tanner, Holland, N. Y., is contemplating the construction of a foundry in connection with his present wagon hardware plant. Mr. Tanner desires information and catalogs on foundry equipment and supplies. A number of new tools will be purchased shortly by the Myerstown Foundry Mfg. Co., Myerstown, Pa. This company recently purchased the plant it had been operating for a number of years from the Treadwell Engineering Co., and will soon make a number of improvements.

Pittsburgh Equipment Demand Slack

RESTRICTED activity among foundries in the Pittsburgh district continues to reflect itself in the lack of demand for equipment. Present complements are more than sufficient for present needs except in isolated cases. However, sellers of foundry equipment, report a somewhat improved volume of inquiry as compared with conditions a month or so ago, and believe this will increase since a large number of foundries need renovation. Current inquiries call for cupolas, flasks, ladles, core ovens and other core-making machinery. The demand for molding machines continues to be well sustained. The Union Steel Castings Co. recently purchased some rollover molding machines to supplant some of the jarring type, one order being booked this week. The Titusville Iron Works, Titusville, Pa., was a recent purchaser of this type of machinery. The Oil Well Supply Co., Oil City, Pa., is putting in foundations for two rollover machines which are to be ready within three weeks. The United Engineering & Foundry Co., Pittsburgh, is disposing of some of its machinery and is making some improvements and installations. It is understood to be transferring considerable work from its Youngstown plant to its local Frank Kneeland works. A few spasmodic inquiries for traveling cranes from foundries are being received but orders are scarce. Another unit will be added to the plant of the Standard Sanitary Mfg. Co., Louisville, Ky., shortly.

Slow Market In Chicago District

OPERATING conditions in foundries in the Chicago district and west are at so low an ebb the market for supplies and equipment is at a standstill. Not only are inquiries almost absent but the utmost efforts of salesmen calling on their regular trade avail little in stirring up business. In a few instances changes and betterments are being undertaken while operation is slack but the total of orders resulting from this cause is small. The Advance Foundry Co., Dayton, O., is planning an addition to its plant. This addition will be used mainly for shipping and receiving, but a part will be devoted to cleaning and storage.

What the Foundries Are Doing

Activities of the Iron, Steel and Brass Shops

The plant of the Fowler Foundry Co., Bradford, Pa., recently was damaged by fire.

The Tennent Steel Castings Co., Centralia, Wash., recently was incorporated with a capital stock of $100,000.

The Keith Furnace Co., Des Moines, Iowa., is having plans prepared for the erection of a manufacturing plant.

The Trumbull Bronze Co., Warren, O., has started operations in its new foundry, which is 40 x 120 feet.

Part of the plant of the Colonial Brass Co., Middlesboro, Mass., recently was damaged by fire.

The Burley Welding Works, Brooklyn, N. Y., is reported planning the erection of an addition to its plant.

The foundry of Hirsch Bros., Milwaukee,

manufacturer of agricultural implements, recently was damaged by fire.

The Sterling Steel Foundry Co., Bradford, Pa., is reported planning to rebuild its plant which was recently badly damaged by fire.

The Zenith Foundry Co., Miller avenue, Detroit, is building a foundry building, 90 x 200 feet.

Capitalized at $10,000, the Randolph Foundry Co., Randolph, Mass., recently was incorporated by A. J. Sanders, Christopher Tangen and J. F. Holmes.

The New Engand Oilless Bearings Co., Boston, recently was incorporated under the laws of Massachusetts, by George E. Parker, George E. Parker Jr., and A. H. Welch.

Waldron & Van Winckle, 27 Wall street, New York, are preparing plans for the erection of a foundry, 115 x 252 feet, for the Windsor Foundry Co., Windsor, Vt.

The Victor Welding Works, New York, recently was incorporated with a capital stock of $20,000, by W. and O. and O. Malinka, 358 East Fifty-seventh street, New York.

The Barkay Co., foundry, Jamestown, N. Y., recently was incorporated with a capital stock of $10,000, by F. A. Richter, W. E. Kidd and H. A. Bauer.

D. J. Renaud & Son, foundry, Carthage, N. Y., recently was incorporated with a capital stock of $20,000, by H. and F. and D. J. Renaud.

The Andrews Dental Casting Machine Co., Pittsburgh, is being organized by A. P. Lindsay, 1267 Frick avenue, Pittsburgh, and a number of others.

Plans are being prepared by the White Fuel Oil Engineering Co., New York, for the erection of a foundry building, 2-stories, 99 x 103 feet.

William Christian, 172 Connecticut avenue, Detroit, and others, have organized the Superior Stove & Stamping Co., and will engage in the manufacture of stoves, etc.

The Lockport Deoxidized Bronze & Metal Co., Lockport, N. Y., has been incorporated with a capital stock of $30,000, by J. C. Rock, P. K. Haber and J. Zaluski.

The Cast Products Co., Cleveland, recently was incorporated with a capital stock of $10,000, by E. N. Corlett, A. G. Borchert, E. R. Janston, S. M. Corlett and H. C. Janston.

I. Cohen & Sons, 36 Prince street, Montreal, Que., has awarded some contracts in connection with the erection of additions to its brass foundry.

Capitalization at $100,000, the Nassau Foundry & Mfg. Co. recently was incorporated with headquarters at Nassau, N. Y., by C. G. and L. X. Zielman and H. B. Woollard.

Richard Allingham, Hudson City, Mich., and others, have organized the South Michigan Brass Foundry, to engage in the manufacture of brass, bronze and other metal castings.

Capitalized at $25,000, the Adjustable Bearing Co., Terre Haute, Ind., recently was incorporated by C. A. and Z. M. Maris, and others, to engage in the manufacture of bearings, etc.

The Mountain City Stove & Mfg. Co., Chattanooga, Tenn., recently was incorporated with a capital stock of $50,000, by John G. Martin, Ernest Martin, H. H. Hadden, D. B. Harris and J. Walter Love.

Capitalized at $25,000, the Seabring Copper Works, Brooklyn, N .Y., recently was incorporated by R. J. Fleissmer, J. D. Maxwell, and F. V. Smith, 97 Clark street, and others.

The Woburn Brass & Iron Foundry, Inc., Woburn, Mass., has been incorporated with a capital stock of $75,000, by Daniel P. O'Brien, Thomas H. Marriman and George H. Foley.

The W. N. Best Furnace & Burner Corp., New York, has been incorporated with a capital stock of $1,000,000, by M. Roger, R. J. Sykes and W. H. Gillen, 1246 Pacific street, New York.

C. Kessel, 150 Nassau street, New York, and associates, have organized the Peabody Brass Works, to engage in the manufacture of brass and bronze castings, and other metal products.

The Chadwick-Carroll Brass Co., Ltd., Hamilton, Ont., recently was incorporated to engage in the manufacture of brass goods, with a capital stock of $40,000, by Walter W. Chadwick, Daniel T. Carroll and others.

The Southern Michigan Brass Foundry Co., Hudson City, Mich., has been incorporated with a capital stock of $5000, to engage in the manufacture of brass, aluminum and bronze castings.

The Waters Arc Welding Corp., New York, recently was incorporated with a capital stock of $100,000, by F. C. Lord, H. A. Miller and A. K. George, 166 West Seventy-seventh street, New York.

Capitalized at $60,000, the Siche Gas Range & Heat Co., Ltd., Toronto, Ont., has been incorporated to manufacture heaters, ranges, stoves, boilers, etc., by Frank J. Hughes, Leo J. Phelan, Daniel P. J. Kelly and others, all of Toronto.

The Pure Hoist Air Furnace Co., Ltd., Ottawa, Ont., recently was incorporated to manufacture furnaces, heating apparatus, etc., with a capital stock of $40,000, by Maurice M. O'Connell, James S. Wilson and others.

The A. W. Cash Co., Ltd., Toronto, Ont., has been incorporated to manufacture castings, etc., with a capital stock of $50,000, by James L. Ross, Arthur W. Holmstead and Arthur B. Mortimer.

The Universal Coupling Co., 5308 Ellis avenue, Chicago, has been incorporated with a capital stock of $50,000, by C. A. Luce, Jacob Katz, H. H. McCormick and others, to manufacture castings, couplings, etc.

The Brant Foundries, Ltd., Toronto, Ont., has been incorporated to build and operate foundries, steel plants, to manufacture iron, steel, metals, castings, forgings, etc., with a capital stock of $40,000, by John Jennings, 169 Lowther avenue, Arthur R. Clute, 67 Yonge street, and others.

After being idle for more than a month and a half, the Standard Foundry Co., Racine, Wis., resumed work on March 1, on a regular schedule on full time. It is expected that by March 10, the entire force of 150 men, which is the normal staff, will have been reemployed.

The Advance Foundry Co., Dayton, O., has advised that it will not need additional equipment for the addition to its plant which it is now planning. This addition will be used exclusively for shipping and receiving, and a part will be devoted to cleaning and storage. The structure will be the same in every detail as the present foundry building, and with its completion the company feels it will be in a better shape to care for its business in a more systematic manner.

Purchase of the controlling interest in the Valley Iron Works of Appleton, Wis., by Ernest Mahler and associates, from W. A. Fannon, Dr. E. A. Morse and Mrs. Bertha M. Peterson, recently was announced. The company conducts a foundry and machine shop and specializes in the manufacture of a new type of papermill beater designed and patented by Mr. Mahler, who is general manager of the Kimberley-Clark Co., Neenah, Wis. E. A. Peterson, who is general manager of the Valley company, will be president under the new ownership.

The Janesville Molding Sand Co., Janesville, Wis., is now under the management of John F. Pember and Thomas W. Nazum, who have purchased the interests of Henry L. and Alva H. Maxfield. The company owns and operates a large tract in the town of Janesville, which produces a high grade of molding sand for foundry purposes. Extensive development of the tract will be undertaken to meet increased requirements from casting shops throughout the Middle West.

Advices have been received to the effect the Liberty Machine Co., Wauwatosa, Wis., has been incorporated with $10,000 capital stock, by William J. Grede, J. Keller and A. E. Strand. The company will take over the manufacture and sale of electrical fixtures, fittings, etc., formery manufactured and sold by the Liberty Foundry Co. The office and plant of the new organization will be on the property of the Liberty Foundry for the present, as the company does not plan additional buildings, etc., at this time. In about six months it plans to purchase some additional equipment.

At the annual meeting of the Schartow Mfg. Co., South Milwaukee, Wis., saddlery hardware, harness chains, small malleable castings and specialties, it was decided to change the corporate title to the Midland Co. Officers were re-elected as follows: President and general manager, R. A. Nourse; vice president, T. E. Ward; secretary and treasurer, C. P. Nourse. The new name was adopted to perpetuate the old name of an industry established many years ago by Mr. Nourse as the Midland Iron Works, which later was acquired by the Stowell Co. of South Milwaukee. Mr. Nourse is vice president and general manager of the Stowell Co. and Mr. Ward is secretary of the same organization. The Schartow company originally was established at Racine, Wis., but was moved to South Milwaukee about a year ago.

New Trade Publications

LOCOMOTIVE CRANES—A 10-ton crane and a 7½-ton locomotive crane is described and illustrated in an 8-page illustrated booklet being circulated by Victor R. Browning, Cleveland. Complete details are given, including specifications, etc., and a general description. Included in the illustrations are several line drawings.

WELDING—A 42-page instruction booklet is being circulated by the Metal & Thermit Corp., New York, containing instructions for the use of thermit welding in railroad shops. The instructions should be of value not only to production engineers but mechanics as well. The instructions are illuminated by line drawing illustrations.

FOUNDRY FLASKS—The American Foundry Equipment Co., 366 Madison avenue, New York, is circulating a 20-page illustrated booklet in which foundry flasks are described and illustrated. This equipment includes corrugated steel flasks, flask bars, snap mold jackets, cast bottom plates, mounting frames and pattern mounting compound.

FOUNDRY MIXER—The National Engineering Co., Chicago, has published a circular containing a list of foundries in all parts of the country, which have adopted as part of their regular foundry equipment the intensive foundry mixer, manufactured by the National Engineering Co.

VENTILATORS—A 4-page folder is being circulated by the V-W Ventilator Co., Columbus, O., in which a new line of metallic ventilators, for use in buildings, cars and vehicles of all kinds, is described and illustrated.

STEEL SHOT—The Globe Steel Co., Mansfield, O., has published a circular in which it calls attention to steel shot in cleaning operations. According to the folder, this shot can be used 200 to 250 times before it becomes ineffective.